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# ENGINEERING AND MINING JOURNAL

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## Churn Drilling of Disseminated Copper Deposits

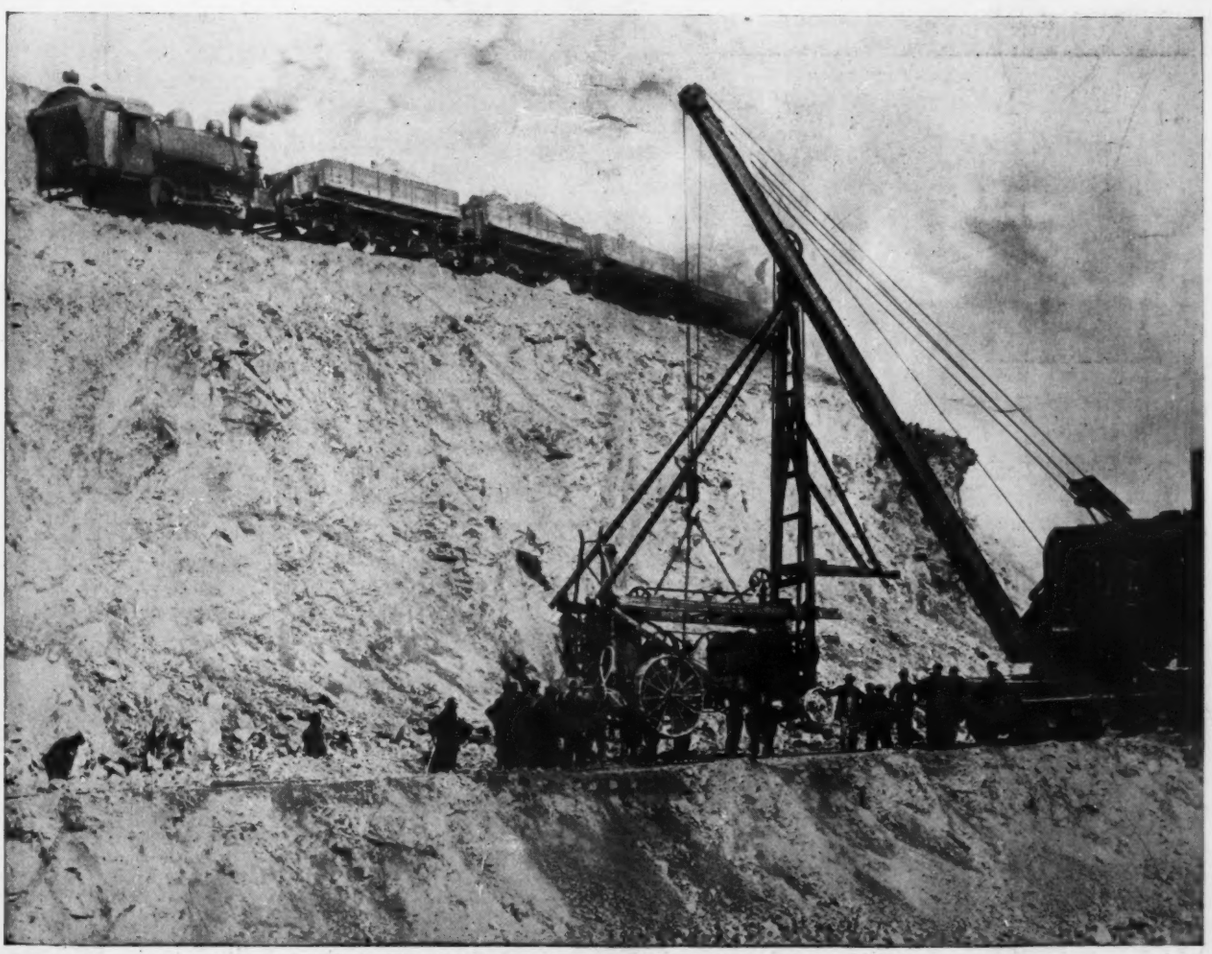
By E. R. Rice

## The Crahall Tailing Plant

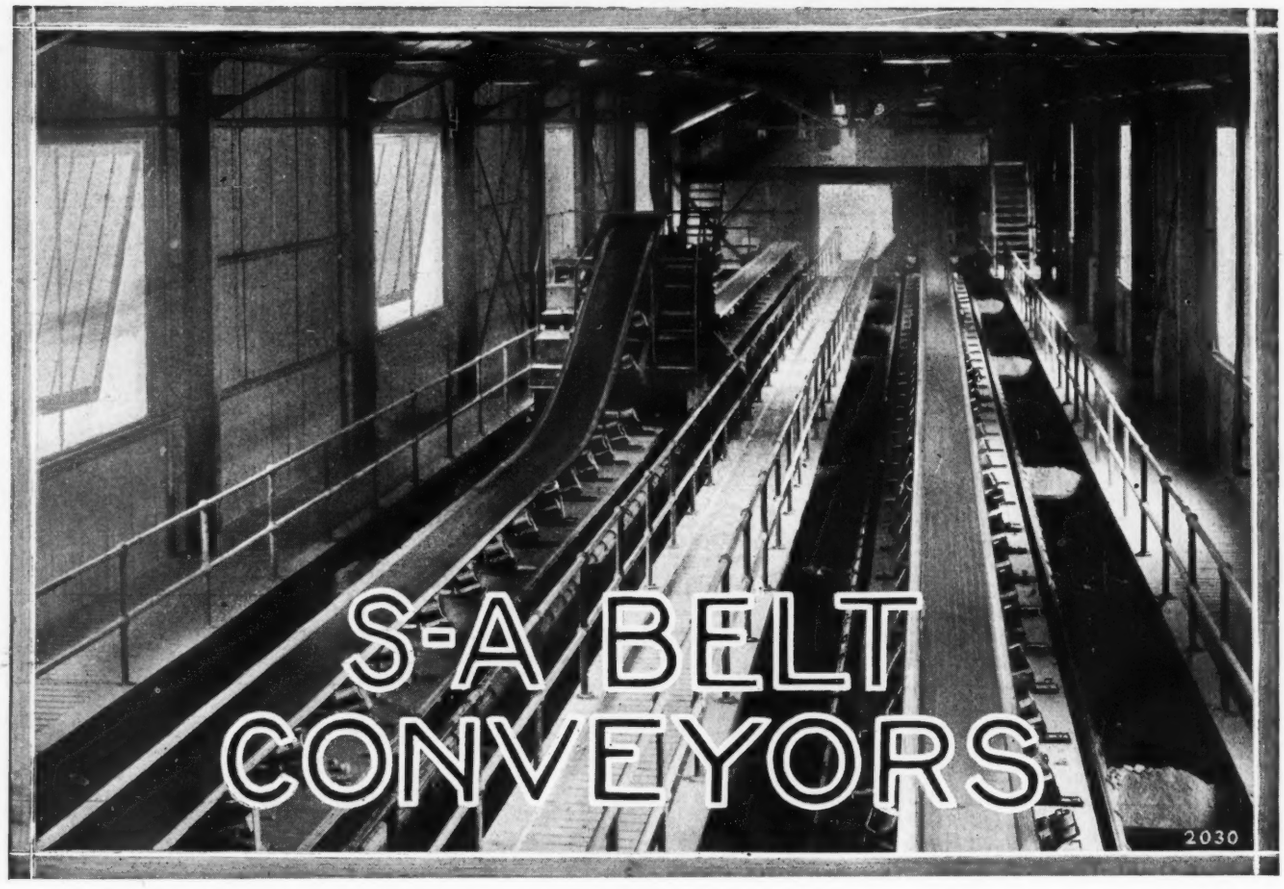
By W. F. Boericke

## Peruvian Oil Fields

By Vernon F. Marsters



Moving Churn Drilling Equipment at a Southwest Porphyry Copper Mine

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# Engineering and Mining Journal

*A Weekly Journal of the Mining and Mineral Industries*
METALS NON-METALS PETROLEUM

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## Substitutes and Imitations

THOSE WHO PRODUCE commodities which sell at a low price have, in one way, somewhat less to worry about than those who handle expensive materials: they need have little fear that someone will come along with a low-priced substitute which will throw their business on the rocks. Among the metals, for example, it is beyond the realms of possibility that in our lifetime anything will displace iron to any marked degree. Lead and zinc, too, are so cheap that the tendency is to use them in place of other metals, rather than the reverse. Copper, even at its present moderate price, is three times as expensive as zinc and approximately ten times as much so as iron. Especially during war time was there a tendency to use substitutes for copper. Aluminum is by comparison expensive, but its increasing use is because it is so light that a given weight of this metal will go as far as more than three times the same weight of copper, for example. As we go up the scale we come to platinum, many substitutes for which have been devised and successfully used. Where its appearance is the chief desideration, as for jewelry, an alloy known as "white gold" has been put on the market.

Considering jewels, the future is somewhat more precarious, though here it is artificial production and not substitution which is feared. The diamond producers are nursing a monopoly most carefully, but the time is almost certain to come when imitation stones exactly like the kind we are accustomed to, and therefore no longer an imitation, will be on the market. Science has already pointed the way. And as for pearls, pearl plating has already been introduced in the oyster family, and the plated article cannot be distinguished from the solid except by breaking it, a procedure with obvious disadvantages. Pearls are ordinarily formed by a parasite working its way into the tissues of a mollusc, whereupon the outraged mollusc immerses the offending intruder in a fluid from which a pearly layer is deposited on the poor germ. The modern idea is to introduce within the shell of a vigorous looking mollusc a "starting sheet" considerably larger than the minute parasite heretofore employed by nature. This makes less work for the mollusc in producing pearls of a given size, and also a bigger profit for the middleman. It is an extension of the idea long practiced in the production of honey in which man takes upon himself certain details in the manufacture of the comb which he can perform more economically than the bee.

Every day takes us a little nearer to the cheapest way of doing things, and if someone devises a cheaper substitute for our favorite product, let *us* try to get the business of those who are making some even more expensive product for which our own can be substituted. And, also, we should never overlook the possibility of materially reducing costs through a radical change in our process.

## The Exhaustion of Radium And Other Metals

A BALTIMORE PHYSICIAN, a "radiologist," Dr. Curtis F. Burnam, who is associated with the distinguished Dr. Howard A. Kelly in the radium treatment of cancer, is reported to be of the belief that the available supply of radium ore in the world will be exhausted in a short time, possibly in ten or fifteen years.

It is difficult properly to estimate the various current prophecies as to the exhaustion of certain rare and valuable metals; but it is certain that most important minerals except aluminum, iron and coal, and some others are being exhausted with varying degrees of rapidity. New discoveries will postpone the intense world shortage that will tend to show itself now in one mineral, now in another, from now on; but within a short space of time, certainly in less than one or two or three hundred years, the world will be very short of a number of metals of which we now have abundance. Aluminum and iron can always be had, for when the abundant supplies of the easily won oxides shall be low, new processes will utilize the silicates, and eventually the basic igneous rocks can be turned into these two metals and others. With the growing trend of the development of electricity, and the extension and perfection of electrometallurgical processes, it is easy to see that these developments will come when they are needed.

As to radium, there are two sides to the question, and no clear prophecy seems possible, because we do not as yet know the facts. It is argued that the amount of radium used for other than therapeutic purposes is trifling. Some geologists who have given special study to the problem are of the opinion that many additional finds of radium ore will be made in the world, and that the limits of our resources are difficult to predict; and in that case the fears of Dr. Burnam will not be realized.

We are, however, now near enough to the facts as to our metal reserves to begin to base an intelligent national policy on them. We have done an immense lot of prospecting, development, and mining, and are getting to the stage where we can constantly make closer and closer estimates of the earth's metal reserves—in sight, probable, and possible. Sound national policies of protection, development, alliance, or trade cannot be made without consideration of these fundamental facts: because they are not of the kind which apply solely a thousand years from now, but begin to be significant and controlling at once. We must substitute for the prophecies of physicians the best available estimates of geologists and mining engineers. This should be made the object of special studies; and these estimates should be revised from year to year, and constantly published. It will be easy, for example, to predict the rate of extraction of a considerable part of our copper reserves, for they have been largely measured.

Who will undertake this basic study, and be so situated as to be free from bias in the fact-finding? The Geological Survey has done splendid work in pointing out the situation in petroleum. If it had not been thus done, it is doubtful if any one would have done it. The whole job, indeed, is one for the Geological Survey. Will it undertake it? No one but a trained geologist is capable of estimating approximate ore reserves, unless it is drilled or developed ground, or ore in the bins or on the dump.

## The Recovery in Gold Mining

THE McFADDEN gold bonus bill is still before the House Ways and Means Committee. Those engaged in mining gold are as desirous as ever for its passage, and from time to time some interested organization passes a resolution expressing this desire. In the meantime, here and there, the situation begins to look a little brighter for the gold miner. Recently at Porcupine, Ont., the Hollinger company increased its operations to full capacity, and conditions in that camp are said to be better than they have been in several years. In South Dakota, at another great camp, the Homestake Mining Co. has just paid a 25c. dividend for the month of May, the first dividend since September, 1919, a hopeful sign, even though it is less than half of the regular payment of 65c. per share. This property is also working at full capacity and has broken ground for an addition to its milling plant.

In California, on the Mother Lode, conditions are not so bad but that approximately 1,500 miners are employed, and, similarly, in the Grass Valley district from 900 to 1,000 are working. Compare this with the situation in the average copper camp. Two big properties, the Argonaut and Kennedy, at Jackson, on the Mother Lode, would probably be operating were it not for the conditions resulting from the fire that broke out in the Argonaut over two years ago.

In Cripple Creek, conditions are reported to be improving. Labor is cheaper, more plentiful and more efficient, and supplies cost a little less. In Arizona, the Katherine-Union Pass district, in Mohave County, has for some time been the scene of a gold "boom" of some dimensions, though to what extent it is justified is something for the future to determine.

Even when things looked darkest for the gold producer, great opposition developed to the McFadden bill. With the dawn of better times this opposition will not lessen. Furthermore, the record-breaking amount of gold in this country is steadily being added to from abroad.

## The Advantages of Exercising the Microscope

HOW MANY FLOTATION PLANTS are equipped with microscopes? It is safe to say that the vast majority are not. Sometimes the mining department of a company is provided with one or more of these valuable instruments, but the flotation department usually either knows not of their existence or understands nothing of their applicability in the study of problems of concentration.

A thorough knowledge of the physical constitution of the substance we are handling is possibly not generally as important in metallurgical work as to know the chemical analysis; still it aids greatly in a proper conception of the problem to be solved. An example of such research is the work of Van Arsdale and Meier on the constitution and behavior of copper particles in slags, which has been made public in the last two or three years. Their experiments caused copper slag losses to be considered in a new light. Recently, the practicability of the microscope in the study of flotation phenomena has been demonstrated by the U. S. Bureau of Mines in its bulletin entitled "Flotation Tests of Idaho Ores."

The ore under examination visibly contained chalcopyrite, pyrrhotite, and pyrite. With the microscope it was discovered that the chalcopyrite was a replacement mineral, filling the pits and cracks of the pyrrhotite, and that the association of the minerals was so intimate and complex that no amount of crushing could set them free. Therefore, it was proved that the low recoveries obtained were not due to any error in manipulation or oils used, and further testing by a variation of these factors was shown to be without promise of tangible benefit.

Microscopical work does not require an unusual degree of skill. Neither does it take much time to polish a specimen and examine it. Even if it did, most copper metallurgists just now would not be deterred on this account, for they are in the position of the shiftless negro who remarked "Time is the onliest thing I aint got nothin' else but." So buy or borrow a microscope—it need not be the finest imported instrument—find out how to use it by reading some book, such as Davy and Farnham's "Microscopical Study and Determination of the Ore Materials," and the chances are that you will make discoveries which will set you to thinking. The expense of such experimental work is small, yet most practical metallurgists have done little in this field, so that the opportunities are all the greater.

## Motion Pictures of Mining Industry

THOSE WHO ARE IN CHARGE of the entertainment at society meetings, at clubs, and at the various places at which men interested in mining occasionally gather, often find it difficult to arrange a program which will be instructive as well as entertaining. To such we wish to call attention to the motion picture films which the U. S. Bureau of Mines and the Canadian Department of Mines have gone to considerable expense to prepare. These pictures show in a most entertaining way, both to the technical and non-technical spectator, many of the leading features of interest in the industries which they cover. They could well be shown in many commercial moving picture theaters in mining towns to the exclusion of some of the eight-reel inanities which we sit through because we have paid our seventeen cents and have no better place to go. We cannot imagine any one who would not be interested in such a motion picture, for example, as "The Story of Petroleum."

The U. S. Bureau of Mines has so far prepared sixty-six such films, which it will loan free of charge for educational purposes in promoting safety, health, welfare, and efficiency in the mining industry. Applications for loans should be made to the Superintendent, Pittsburgh Station, Bureau of Mines, Pittsburgh, Pa., who will furnish a list of the subjects and give all desired information. Arrangements can also no doubt be made for securing the many interesting films which have been prepared by the Canadian dominion and provincial governments.

## The Decrease in Wages

WAGES PAID "on company account" in mining camps throughout the United States have with some exceptions fallen below the scales in effect on Jan. 1, 1919, or, roughly speaking, at the time the Armistice was signed. This, however, was not the high point, for wages continued to rise after the Armistice, so that fourteen months later, at the beginning of 1920, the increase was marked. The late spring of 1920 saw still further increases in some instances, but by the fall of last year the tide had definitely turned and wages generally began to drop.

The contract system of paying miners is widespread, and a large part of the miners of the country are working under some form of wage contract, or would be if conditions were normal. The fall in straight day wages, however, is a fair criterion of the decrease in income today of the miner who is actually employed. "Actually employed" is to be stressed, for although a certain wage scale may obtain in a particular camp, a negligible number of men may be working.

In the news pages in this issue we tabulate the wages paid at fifty different camps in the United States as reported by sixty-one companies. In some cases, it will be noted, the decrease is slight and in others wages have not fallen at all. In particular, at Grass Valley and at Shafter, Tex., they appear to have risen. But in general the decrease is noticeable.

## Domestic and Foreign Business Tactics

FOR MANY WEEKS the people of New York City have been able, through newspaper accounts, to scrutinize reports of shady and often criminal business practices, as the Lockwood committee, which was originally appointed by the state to investigate the local housing shortage, has, in its work, peered under the lid of many stupid and some adroit business methods of mulcting the public. The exposition of these methods has furnished many an interesting story of graft and criminality, and has clearly disclosed the fact that neither capital nor labor has entirely clean hands.

A few of the guilty have been imprisoned, many have been fined, and a large majority have been cautioned to alter their highly questionable business practices, the general rule being to imprison the labor leaders and to fine the business men. The scope of the inquiry has progressed further and deeper than was apparently originally its purpose and intent, and has shown that many artificial restrictions to trade, rather than the normal functioning of economic laws, have been responsible for hardship to the public in the building situation. Labor organizations, trade and price-fixing associations in building materials, insurance companies, and many other businesses have been dragged in the net—and a complete haul has not yet been made.

The exposure of these evil American business practices is a sad commentary upon our laws, upon our much-vaunted superiority in commerce, and our attempt to establish the nation firmly on the pinnacle of international trade. While responsible and comprehensive efforts are being made by far-sighted executives in government and business to intrench the foreign trade gained during the war, our internal commerce has been and no doubt still is being hampered and given a black eye by the greed of many business men and labor leaders. This is not exactly the sort of preparation one would expect from a country that intends to tune itself to international commerce and to occupy a dominant position in the world's finances, efforts that require a high order of business intelligence.

The important lesson that is apparent from the Lockwood exposures is the need for thorough reorganization and elimination of many sharp business practices, and for a moral regeneration, not only for the protection of the public, but for the better domestic organization of labor and capital to meet the intense effort that will be required to compete successfully in foreign trade.

Although we have great confidence in the integrity and undoubted honesty of by far the vast majority of American business men, it behooves them to see that their good name shall not be sullied by the tactics of reprobates among them. Tariffs, governmental loans, subsidies, and other palliatives can do little to bolster trading that is an offspring of sharp domestic business practices. Much good can come out of the Lockwood investigation, or any other similar investigation, if the lessons indicated are taken to heart, remedies instituted to remove the legal loopholes open to the law's evaders, and, above all, if an inward and conscientious attempt is made to improve the morality of American business.

## The Institute Mining Methods Committee

THE American Institute of Mining and Metallurgical Engineers has formed a strong committee on mining methods, under the chairmanship of Mr. John C. Hodge, of Minneapolis. There is a great field of work for this committee, if certain proposed plans are carried out. There is much about up-to-date mining methods that is not to be gleaned from literature, although there are enough engineers who are expert in the special problems to make a systematic presentation and record easily possible. There is considerable talk, in this case, of the committee working on a definite plan, and this is a method which the Institute as a whole would do well to consider.

The papers of the Institute have always been practically spontaneous. Although committees on various subjects exist, the main or sole object of such committees has been to solicit papers—not papers on a certain subject, or so solicited that they would fit together, but just papers. But lately some of the most energetic and constructive of these committees have worked on a plan, and attracted much favorable attention thereby. The collection of papers on drill steel recently got together by Mr. B. F. Tillson is an example; another is the petroleum contributions brought out by the committee of which Mr. Ralph Arnold is chairman.

A carefully worked-out and assigned series of papers on mining methods would be very valuable. We do not recall any satisfactory treatment of stoping methods even, or of timbering methods, or of blasting methods, of methods of moving rock underground, or indeed of many other phases of mining, coupled with studies of the conditions under which each is to be applied. The men that are expert in these matters in too many cases are precisely the ones who will not volunteer papers on them; no man is anxious to write on matters which are so thoroughly known to him that they have no longer the charm of novelty. But an active working committee could put responsibility on such men, and induce them to contribute, for the making of a systematic and mutually related record.

# WHAT OTHERS THINK

## Selective Converting in South Australia

The article published in *Engineering and Mining Journal* of Feb. 5, "Selective Converting at Clifton, Arizona," by J. Owen Ambler, has been read with a good deal of interest here, as "bottoming" has been carried out at Wallaroo for a great number of years. Originally the method was practiced when the matte was roasted in reverberatory furnaces which were tapped on the regule stage after "coppering" for a short period. The beds for retaining the "bottoms" were made up near the tap hole so that the copper would be trapped in the first half dozen pigs. When the bed cooled, the impure copper was stripped from the regule and transferred to the electrolytic department to eliminate impurities and recover the gold and silver.

When the bessemerizing process was adopted at Wallaroo the "bottoming" was continued, with even better results than in the reverberatory roasters. In 1906 an engineer who had left the Wallaroo company's services and taken over the control of the O. K. mine, in Queensland, applied this method of selecting to the recovery of precious metals during the bessemerizing of matte.

There is no doubt the "bottoming" process in converting copper mattes is of considerable service where the precious metal values are low, as it also assists in removing small quantities of impurities and makes the bulk of the "blister" suitable for direct refining. As is well known, an appreciable amount of gold and some of the silver collect in the bottoms, which, at Wallaroo, are tapped through the side of the vessel opposite and directly above the tuyère line. The tap hole is drilled in the side of the shell and is continued by driving a 1¼-in. bar through each new lining before it is dry, and this hole is kept free by allowing a bar to remain in it during blowing operations.

The matte charged is raised to the white-metal stage, and after removing the final slag, blowing is continued for twenty-five minutes, or whatever time is considered necessary to form a suitable "bottom," depending upon the quantity being treated. When sufficient copper has formed, the vessel is turned over, and a small quantity of matte shell is dumped into the charge. Blowing is resumed for about five minutes; this "tightens" up the regule and insures a minimum of metallic copper being held in the white metal. The converter is then turned over for about five minutes, when the bar is withdrawn and the copper allowed to run into sand moulds made up underneath the vessel.

As soon as the regule begins to show in the issuing stream, the vessel is returned to an upright position and the hole temporarily closed with a clay stopper. Subsequently the bar is again driven into the hole and the remainder of the metal blown to blister copper. The quantity of "bottoms" made varies according to requirements, but the usual practice is to run off about 16 per cent of the total copper, as under present working conditions this gives the most satisfactory result.

The recoveries of gold and silver average about 75 per cent and 28 per cent respectively. The silver recovery cannot be expected to be high, owing to its affinity for white metal being almost equal to that of metallic copper. During the last eleven years, 9,500 tons of "bottoms" have been produced in the converters, containing 2.5 oz. gold and 2 oz. silver per ton. The removal of impurities is the first consideration in making best select copper, and of course every attention is also paid to the recovery of the gold and silver which would otherwise be lost.

It may be stated that H. L. Collins[1] has published results of the same class of work which he introduced at the Huelva mine, Spain, in 1914. It is evident that in this instance the practice at Wallaroo had been followed in detail, with the exception that no raw matte was added to the charge on the eve of tapping the copper bottom.

H. LIPSON HANCOCK.

Wallaroo, South Australia.

## The Chloride Volatilizing Process

In the *Engineering and Mining Journal* of Nov. 26, 1920, an article by Jay A. Carpenter is printed in which I am mentioned. Mr. Carpenter states in one paragraph: "Calcium and magnesium chlorides appear to react and volatilize faster and at a lower temperature than sodium chloride. I cannot, however, agree with Harai R. Layng that they are so much superior to sodium chloride as chloridizing and volatilizing agents. In fact, on oxidized silver ores I have been unable to make a high volatilization recovery of the silver with either of these chlorides or with sodium chloride, with a temperature of over 1,000 deg. C. for one hour, with rabbling and a fairly strong current of air."

His statement in the first sentence of that pararaph is in agreement with my published statements of an earlier date.[2] His attempt, however, to support his failure to agree with me, I consider weak. His failure to obtain high volatilization with calcium chloride on an ore which would not yield a high volatilization with sodium chloride is no proof that calcium chloride is not better than sodium chloride. He may have had an ore which could not be treated by chloridizing volatilization or he may have had an ore which would not yield good results by the methods of chloridizing volatilization which were used or known by him. The ore used may have required special treatment such as fine grinding, the presence of water, vapor, rapid heating, low oxidizing conditions, no rabbling or a different method of adding the chloridizer. It would be interesting to know whether the ore yielded better results by chloridizing cyanidation than those obtained by volatilization.

Each ore may require different treatment, and although I am willing to admit that chloridizing volatilization may fail on some ores of silver, I must say that of the many ores I have tested I have not tried one which did not give higher silver extractions by properly applied chloridizing volatilization methods than could be obtained by other methods excepting smelting.

In opposition to the main point of his article, I mention that I have been able to get high extractions by

[1] *Trans.* Inst. Mining and Metallurgy, Vol. XXIV, p. 489.
[2] *Min. & Sci. Press*, Jan. 17, 1920.

laboratory tests with chloridizing volatilization on samples of the tailings resulting from the cyanidation of Tonopah ores. I have recently done considerable work on an oxidized lead-silver ore which would not yield over 7 per cent extraction of the silver by concentration or flotation tests, and which would not yield any appreciable extraction by amalgamation or cyanidation even after chloridizing roasts, but which gave 60 per cent extraction by laboratory and over 70 per cent extraction by large-scale chloridizing volatilization tests. The lead extraction by concentration was about 70 per cent, and by volatilization the extraction was complete. The silver was not associated with the lead, but it was apparently combined with the silicate of alumina of the ore.

There are exceptional ores which, when mixed with a chloridizing agent like calcium chloride and placed in a muffle, will cause the calcium chloride to be rapidly decomposed, and the effective chloridizing agent will be volatilized before attracting most of the silver. With such ores sodium chloride may prove better than calcium chloride if the calcium chloride is not used as I use it in my processes.

Contrary to Mr. Carpenter's statement that the Cottrell method is the method relied upon to recover all of the silver, lead, and copper as volatile chlorides, I may mention that the Cottrell people do not claim that they can recover *all* of the silver, lead, and copper as volatile chlorides; furthermore, I do not depend upon the Cottrell system. In fact, I do not use it. I generally use absorption systems, and would use bag-houses in the exceptional instances where absorption systems would not be suitable. My recovery systems are highly efficient.

My absorption system recovers in an available form practically all of the chlorine added to the ore except that which is combined with the volatilized metal chlorides, like lead chloride, which latter is recovered later in my processes in an available form. Experience with my processes has shown that most of the chlorine of the excess calcium chloride used is volatilized as hydrochloric acid and chlorine and that little is volatilized as calcium chloride; therefore, the amount of the excess chloridizer recoverable by the Cottrell system would be small indeed, unless use is made of absorbents. It will be advisable for me to mention here that I have covered the use of absorbents in patent applications and that I disclosed to Mr. Church, a Western Metallurgical Company's representative, upon his visit to my office some months prior to my publication on "Chloridizing Processes" the nature, description, application, and advantages of absorbents either with or without the Cottrell system, and that these points were news to Mr. Church.

Mr. Carpenter states that "the scope of the process depends principally upon the oil consumption per ton of ore, not only to chloridize the ore but also to maintain the necessary temperature at which the large stream of heated air gradually picks up and carries off the chlorides from the roasting furnace to the collectors." In another part of his article he states that the fuel required to heat "a ton of ore to 1,000 deg. C. and keep it there a sufficient time to volatilize the metals is variously estimated at from 15 to 25 gal." He states that for chlorination purposes only, the ore heated to 900 deg. C. for a short time, as thirty to forty-five minutes, would require less fuel than this.

My experience has been that the extractions by my chloridizing volatilization processes can be obtained in less than one-half of the time stated by Mr. Carpenter to be required for chlorination only. In trial with my processes a greater percentage of silver volatilization was accomplished in nine minutes in a large furnace than was obtained in laboratory tests in from ten to sixty minutes, and the indicated fuel consumption was considerably less than the lowest figure given by Mr. Carpenter. The amount of air required for volatilization is not nearly so great as the amount required for roasting. My experience has been that the fuel and chlorine consumption in chloridizing volatilization will be considerable less than in chlorination roasting and less than Mr. Carpenter states.

Chlorination roasting followed by cyanidation may sometimes prove advantageous under peculiar and unusual conditions, but I doubt whether it will prove more advantageous in the majority of cases of oxidized silver ores than will chloridizing volatilization.

San Francisco. HARAI R. LAYNG.

## Chloridizing Practice in Sweden

I have only recently read Mr. Van Arsdale's comments on my article published in *Engineering and Mining Journal* of April 2, to which Mr. DeFries has kindly replied. Regarding Mr. De Fries' reply I beg to give some additional information: The cement copper secured in the mechanical precipitator described in my article (*Engineering and Mining Journal*, March 5, 1921) contains on a dry basis, about: Cu, 85 to 90 per cent; Fe, 2 to 3 per cent; and Cl, less than 0.2 per cent. The percentage of iron in the cement copper is to a large extent governed by the quality of scrap iron which is being used, and also by the care with which the cement copper is separated from the remaining iron scrap and then washed. Most of the iron present is either in the metallic state, or as rust, or as basic iron compounds. The weaker the copper solutions are the more likely are basic iron salts to be thrown down with the copper. If a high-grade cement copper is to be secured, it is therefore important that the copper liquors are kept as strong as possible. The chlorine content is also governed by the washing process, and as the cement copper is washed in filter presses, the water-soluble chlorine can be removed to a minimum.

When copper is precipitated in tanks, there is a strong tendency toward the formation of cuprous chloride, insoluble in water. This subchloride has little chance to form in this mechanical precipitation process.

The high content of sodium sulphate given by Mr. De Fries clearly indicates that this cement copper had been poorly washed. In case of copper solutions containing appreciable amounts of precious metals, the Claudet silver process can be applied before the cementation, or the cement copper must otherwise be smelted into anodes, these to be refined electrolytically. When the cement copper does not contain precious metals, the smelting and refining operation, as carried out in Helsingborg, produces a copper equal in quality to the best "Best Selected Copper." This copper has a purity of 99.87 per cent. The cost of this refining process is said to be low.

I may finally mention that a method to refine the cement copper by electrolysis without a previous smelting has been developed and carried out on a commercial scale in Helsingborg. I am, however, not familiar with the details of this process. NILS OSTMAN.

Upsala, Sweden.

CHURN DRILL, SHOWING HOLE IN PROCESS OF BAILING. ALSO ARRANGEMENT OF SLUDGE LAUNDER AND SAMPLE SPLITTER

Tubs at right contain samples being dried over coal fire.

# Churn Drilling of Disseminated Copper Deposits—I

## Ability To Do Necessary Work and Reliability of Operation Should Govern Selection of Equipment—Problems and Methods of Drilling —Accuracy and Reliability in Sampling Insure "Cost Per Sample" Perspective and Secure Dependable Results in Drilling Operations

BY E. R. RICE

Written for *Engineering and Mining Journal*

DURING the past decade, the copper supply of the world has been profoundly influenced by the advent of the so-called "porphyry" copper mines. In the blocking out of the enormous tonnages of ore necessary to the economic exploitation of these mines, churn drilling has played an important part.

The accompanying table, compiled from the 1920 edition of *The Mines Handbook*, shows the relationship of the production of the leading "porphyries" of the United States to that of the entire world. Although there are other large mines of this type, notably in South America, the main ones of the United States are chosen, as it was the enterprise and ability of the men connected with these pioneers that has brought the art of mining and milling low-grade copper ore to its present state of efficiency.

PRODUCTION OF LEADING "PORPHYRIES" FOR THE YEAR 1918

| Name of Company | Situation | Year of Initial Production | 1918 Production in Lb. of Copper |
|---|---|---|---|
| Utah Copper | Utah | 1904 | 184,460,168 |
| Nevada Consolidated | Nevada | 1907 | 81,037,777 |
| Ray Consolidated | Arizona | 1911 | 83,599,160 |
| Miami | Arizona | 1911 | 58,407,563 |
| Chino | New Mexico | 1911 | 79,340,372 |
| Inspiration Consolidated | Arizona | 1915 | 98,540,041 |
| Bisurro Mountain Branch, Phelps Dodge | New Mexico | 1916 | 15,188,619 |
| New Cornelia | Arizona | 1917 | 46,950,139 |
| Total | | | 647,523,839 |

The world's production for 1918 was 3,066,578,758 lb. The eight mines listed in the table produced 21.1 per cent of this, or over one-fifth of the production of the entire world. The year 1918 is used for this comparison because during that year all of the copper mines were running to capacity.

The following are the principal economic considerations in the development of this type of ore deposit: The determination of the existence in the formation undergoing exploration of copper minerals of a grade high enough to warrant mining if found in large enough quantities; the development of sufficient tonnage to warrant mining and milling, and the development of this tonnage as rapidly as possible in order to bring the property to an early production stage, intelligently plan mining methods, and determine the best type of milling plant to be used.

Practically all of the disseminated deposits of copper ore lie in or near intrusions of granite-porphyry, monzonite-porphyry, or quartz-monzonite-porphyry and are overlain by a capping that varies in thickness from a few feet to as much as 1,500 ft.

At the beginning of prospecting operations on a supposed copper deposit the grade, tonnage, and location of the orebody are unknown. These factors should be determined with a minimum expenditure of time and money. Drilling, either churn or diamond, offers the best solution of this problem. This is true especially in the earlier stages of the enterprise, for the outfit is portable and may be easily moved from one location to another, thus allowing the different formations to be prospected in the order of their relative geological merit. Furthermore, the drilling equipment can be assembled and definite information obtained more rapidly than by regular sinking and drifting, the scale of operations can be expanded at will, and, in majority of operations, the cost of obtaining data is less than by regular sinking and drifting.

## Formation Determines Drilling Equipment and Practice

The choice of proper equipment depends primarily on the formation to be drilled. In most instances the churn drill will be preferable to the diamond drill, though in some operations the latter will be more advantageous. At the beginning of operations in which all factors are unknown, the choice lies unquestionably with the churn drill. The principal reason for this is that the churn drill is suitable for either hard or soft ground, irrespective of whether it is massive or shattered, whereas the diamond drill is at a decided disadvantage, both from an operating and sampling standpoint, when operating in a formation that will not core readily. I do not wish to give the impression that the churn drill is always to be preferred, for there are cases where the diamond drill can be used to advantage. The point I wish to make is that in starting operations in unprospected territory it is better to begin with a churn drill, for one is sure of obtaining the desired information, whereas with a diamond drill one may not be able properly to drill the formation under consideration. The more I have to do with mining enterprises, the more I am convinced that in the selection of equipment the primal requisites are ability to do the work necessary and reliability of operation. Other factors are of secondary importance.

After a few holes have been drilled and the salient factors determined, if operations are expanded the final choice between churn and diamond drill may be made.

Most of the disseminated orebodies occur in altered brecciated material, traversed by numerous joints, slips, and faults, so that in most investigations the churn drill will be found preferable for all work.

The following equipment is recommended for initial prospecting work in new territory. Of course, if operations are being conducted in a district where salient factors have already been determined, the equipment can be better chosen to suit local conditions. The accompanying equipment list is based on the possibility of having to drill to 1,000 ft. in depth, in a strange formation:

### RIG

One No. 24 Star traction type drill complete with temperscrew, belt, mast-guys, turn-buckles, guy-stakes, and other necessary parts. Drill to be equipped with No. 25 boiler, boiler to be lagged and lagging held in place with Russia iron.
Three No. 2 Barrett automatic lowering jacks.
Four handles for above (forged handles).
Two 2-in. x 14-in. screw jacks.
One 10-ft. derrick crane with traveler.
One 1-ton Yale geared chain block.
One No. 2 Barrett swivel wrench.
One scoop shovel.
One ½-pint oil can.
One 1-pint oil can, long snout.

### MISCELLANEOUS DRILLING TOOLS FOR 6¼-IN., 8¼-IN., 10-IN. AND 12-IN. HOLES

One No. 2 Barrett wrench circle and jack.
One set manila rope clamps.
One set Mechling wire-line rope clamps for ⅞-in. wire line.
One set ordinary wire-line rope clamps for ⅞-in. wire line.
One right-hand tool wrench for 3¾-in. square.
One left-hand tool wrench for 3¾-in. square.
One bailer, 9-in. outside diameter by 10 ft. long, dart valve.
One bailer, 7-in. outside diameter by 12 ft. long, dart valve.
One bailer, 5-in. outside diameter by 14 ft. long, dart valve.
Three drilling stems 4½ in. diameter by 20 ft. long, 5¼-in. diameter box.
Two drilling jars, 6-in. stroke, 5¼-in. diameter.
Two 12⅜-in. full mother hubbard bits, 5 ft. long.
Two 10-in. full mother hubbard bits, 5 ft. long.
Two 8¼-in. full mother hubbard bits, 5 ft. long.
Two 6¼-in. bits, 5 ft. long.
Two wood-pecker manila rope sockets, 2½-in. bore, 5¼-in. diameter box, neck 3½-in. diameter x 8-in. long.
Two wire-line rope sockets bored for ⅞-in. wire line, 5¼-in. diameter box, neck 3½-in. diameter x 8-in. long.
All stems, jars and sockets to have full squares of 3¾ in. All stems, jars, sockets, and bits to have 2½-in.x3½-in. 7-thread joints, flat threads.

### MISCELLANEOUS DRILLING TOOLS FOR 4½-IN. HOLE

Two 20-ft. stems, 3⅝-in. diameter, 3¾-in. diameter box.
Two drilling jars, 8-in. stroke, 3¾-in. diameter.
Two wire-line rope sockets bored for ⅞-in. wire line, 3¾-in. diameter, neck 2⅞-in. diameter by 6 in. long.
Two 4½-in. bits, 5 ft. long.
One dart-valve bailer, 3½-in. outside diameter by 16 ft. long.
One right-hand tool wrench for 3-in. square.
One left-hand tool wrench for 3-in. square.
All stems, jars and sockets for 4½-in. hole to have 3-in. full squares. All stems, jars, sockets and bits to have 1⅝-in. x 2½-in. 8-thread joints, flat threads.

### FISHING TOOLS FOR 6¼-IN., 8¼-IN., 10-IN. AND 12½-IN. HOLES

One wall hook for 10-in. hole, 10 ft. long.
One wall hook for 8¼-in. hole, 10 ft. long.
One slip socket for 8¼-in. hole, with bowl for 10-in. hole, slip socket bored to go over 5¼-in. joints.
Two medium and two heavy slips for slip socket.
One combination socket to run in 6¼-in. hole and bored to catch rope socket, neck 3½-in. in diameter.
Two sets plain slips for combination socket.
One set pin slips for combination socket to catch 2½-in. x 3½-in. 7-thread pin.
One horn socket for 6¼-in. hole.
One horn socket for 8¼-in. hole.
One horn socket for 10-in. hole.
One heavy center rope spear with collar small enough to run in 6¼-in. hole.
One three-prong rope grab for 10-in. hole.
One three-prong rope grab for 6¼-in. hole.
One 16-ft. jar bumper.
One latch jack to run in 6¼-in. hole.
One 10-ft. side spud to run in 6¼-in. hole.
One 30-ft. spear to run in 6¼-in. hole.
All fishing tools above to have full squares of 3¾-in. and 2½-in. x 3½-in. 7-thread joints.
One horse-shoe trip rope knife complete with sinker and jars for cutting.
Two ½-in. manila line.
One Spang jar-down wire rope knife complete with sinker, jars, and swivel to run in 4½-in. hole and cut ⅞-in. wire line.

### FISHING TOOLS FOR 4½-IN. HOLE

One slip socket to run in 4½-in. hole and catch neck of rope socket 2⅞-in. diameter.
Two sets slips for slip socket.
One combination socket to run in 4½-in. hole and catch neck of rope socket 2⅞-in. in diameter.
Two sets plain slips for combination socket.
One set pin slips for combination socket to catch 1⅝-in. x 2½-in. 8-thread pin.
One horn socket for 4½-in. hole.
One center rope spear for 4½-in. hole.
One latch jack for 4½-in. hole.
One 10-ft. side spud for 4½-in. hole.
All fishing tools for 4½-in. hole to have 3-in. full squares and 1⅝-in. x 2½-in. 8-thread joints.

### CASING AND CASING TOOLS

400 ft. 40 lb., 10-thread, 10-in. California special casing.
700 ft. 28 lb., 10-thread, 8¼-in. California special casing.
1,000 ft. 20 lb., 10-thread, 6¼-in. California special casing.
1,200 ft. 12 lb., 10-thread, 4½-in. California special casing.
Two each 4 ft., 6 ft., 8 ft., 10 ft. and 12 ft. nipples for each string of casing.
Four extra couplings for each string of casing.
Two casing shoes for each string of casing.
One steel casing nipple with male and female threads for each string of casing.
One forged-steel drop drive head for each string of casing.
One set drive clamps and wrench to fit tools with 3¾-in. square.
One set drive clamps and wrench to fit tools with 3 in. square.
Two 50-ton hydraulic jacks with 18 in. run-out.
One spider with liner and slips to take from 12½-in. to 4½-in. casing.
One set Fairs patent elevators for 10-in., 8¼-in., 6¼-in. and 4½-in. casing.
One 2½-in. tubing hook.
One 4½-in. casing hook.
One 20-in. single, one 20-in. double and one 20-in. triple iron casing blocks.
Two large chain tongs, with extra jaws and chain.
Two medium chain tongs, with extra jaws and chain.
One 10-in., one 8¼-in., one 6¼-in. and one 4½-in. Henderson trip casing spears.

BLACKSMITH TOOLS

One 200-lb. anvil, one 2-lb. ball-pein hammer, one 14-lb. cross-pein sledge, one 14-lb. straight-pein sledge, one set bit gages from 12½ in. to 4½ in. inclusive.
Six 2-in. hot cutters, four 1½-in. track chisels, one bar ⅞-in. hexagon tool steel.
One 1-in. crowbar 6 ft. long, one 1¼-in. crowbar 6 ft. long, one 20-in. straight tongs, one 24-in. straight tongs, ½-in., ⅝-in. and ¾-in. bolt tongs, one 20-in. rivet tongs.
Two bars each ½-in., ⅝-in., ¾-in., ⅞-in. and 1-in. round iron.
Miscellaneous assortment bolts and nuts.
Miscellaneous assortment of nails, preferably keg of 8d, 10d, and 40d.
One set taps and dies from ¼ in. to 1 in., pipe stock and dies from ⅛ in. to 2 in.
One combination 6-in. vise, pipe cutters, one ratchet drill and bits from ¼ in. to ⅞ in. x 1/16 in., six 14-in. mill files, six 8-in. mill files.
Twelve 8-in. triangular files, one hack saw and two dozen 12-in. hack-saw blades.

CARPENTER TOOLS

One hand saw, one steel square, one level, one claw hammer, three wood chisels ½-in., 1-in. and 1½-in., three assorted screw-drivers, one brace and set bits from ¼ in. to 1 in., one expansive bit to bore up to 2½ in., one draw knife, one adze.
One poll ax, one hand ax.

DRILLING CABLE AND SUPPLIES

500 ft. 2½-in. Tubbs hawser-laid manila drilling cable.
1,500 ft. Leschens California special ⅞-in. steel drilling cable.
1,500 ft. 7/16-in. sand line.
Twelve ⅞-in. Crosby wire rope clips.
Twelve 7/16-in. Crosby wire rope clips.

MISCELLANEOUS SUPPLIES

Three gasoline torches or three carbide lamps. Six lanterns, two dozen lantern globes, twelve 36-in. sledge-hammer handles, twelve machinist-hammer handles, one 8-in. monkey wrench, one 12-in. monkey wrench, one 14-in. monkey wrench, one 8-in. Stillson wrench, one 12-in. Stillson wrench, two 14-in. Stillson wrenches, one set assorted S wrenches, two flue scrapers, one beading tool, one flue roller, miscellaneous pipe, fittings and valves depending on water supply.
30-ft. ¾-in. hose, one dozen gage glasses, three dozen gage glass gaskets, gasket rubber, assorted, packing for engine, one 50-ft. metallic tape, 25 lb. good-grade babbitt for bearings, 50 lb. poor grade babbitt for rope sockets, shovels, picks, pick handles, 10 ft. each of ⅜-in., ½-in. and ⅝-in. chain. 10 ft. of 2 in. x 10-in. oak board.
Four 400-gal. capacity water tanks for rig.
One 5,000-gal. main storage water tank.
One sample splitter, one sample drier, two dozen ore sacks, 100 6-in. x 12-in. sample sacks.

EXTRA PARTS

Two wrist pins for crank, one wrist pin for deep-groove pulley, one wrist pin for slide arm, one temper screw complete, one set balls and races for temper screw, one injector, one lubricator, one sand reel eccentric, one sand pulley, one set belt clamps and bolts, one walking beam, one walking-beam saddle, one pinion and yoke for friction shaft, one pittman, one set grate bars.

## System of Co-Ordinates Advisable

The first hole should be drilled in the most promising area, geologically, and at one of the co-ordinate intersections of the co-ordinate system decided upon. The standard accepted practice in development has been to divide the area to be drilled into a series of squares measuring 200 ft. on a side and drill holes at the corners of these squares. For this purpose the property is divided into squares by a co-ordinate system, the distance between parallel ordinates and abscissi being 200 ft. The 200-ft. interval may be accepted as standard practice, as the data derived from the use of this interval have been proved reliable in the mining of millions of tons of ore by different companies.

In laying out the co-ordinate system, the origin of co-ordinates should be taken to the southwest of the property, so that all points on the property will be in the northeast quadrant. In the designation of hole locations, the best method is by indicating the number of feet the hole is north and east of the origin of co-ordinates. For instance, the location of a hole that is at the intersection of the ordinate 1,600 North and abscissa 1,800 East would be designated as N 1,600, E 1,800.

The system should be laid out accurately with transit and tape and the meridian determined to within thirty seconds of arc and co-ordinates laid out due north and south and east and west; for if this is not done, drilling maps will not check with regular property maps. If the above scheme is followed, all surveys can have a common origin of co-ordinates and a great deal of time and trouble will be saved. The system need not be laid out in its entirety, for the position of the first hole may be assumed and the co-ordinate system expanded from it.

## Conditions Governing Shift Basis

One of the important points to be decided at the beginning of operations is the number of shifts to be employed, whether one, two, or three. Where the property is under option and time is an important factor due to impending payments on the property, three shifts will be the logical number. Later it may be found to be advantageous to operate only two. A great deal depends on the character of the ground and the personnel of the crews. By operating three shifts, the plant is worked to capacity and overhead expense is reduced, but it will be found that a great deal of trouble will be experienced on the "grave-yard" shift. The only satisfactory method of operating on a three-shift basis is where there are enough drills in operation to employ a night foreman, so that close supervision of the work may be assured.

In some articles on churn drilling I have noticed that a greater footage is sometimes indicated on the night shift as compared with the day shift. For the benefit of those not familiar with this class of work I will say this is probably due to the fact that all repairing and such work is done by the day shift.

At the beginning of operations where only one drill is employed the crews will comprise one driller and one helper to each shift, one of the drillmen acting as foreman. There will also be a teamster, who hauls fuel, casing, tools and other supplies. Besides those mentioned there should be a technically trained man who combines the duties of sampler, assayer, and engineer.

## Selection of Suitable Foreman Important

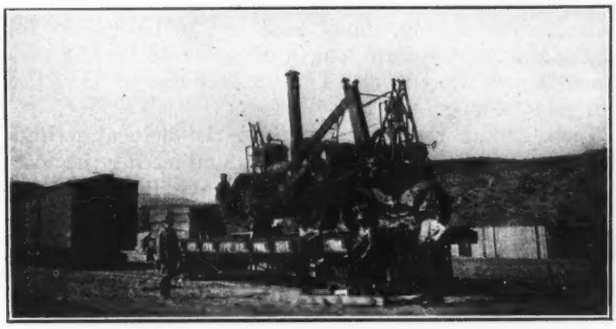
Great care should be taken in the selection of the foreman, for upon him devolves the successful prosecution of the work. It will be found in churn drilling, more than in most lines of work, that the men need careful and intelligent handling. Petty jealousies between individual drillers often lead to a great deal of grief, and the company is the loser thereby. Many drillers think they know more about drilling than any other man on the job, the foreman not excepted. This is easy to understand, for some of the drillers may have been foremen on other jobs and it may happen that the foreman on the present job may have worked alongside of, or for, some of the drillers now under him. There is a general tendency among drillers to leave everything to the foreman, and this is exemplified by the following expression, which is as standard as a 10-in. bit: "I'm not paid to think. I'm paid to dig the hole." The foreman has no easy job, and it takes an exceptionally good man to get the best out of the men.

The principal qualifications of a good foreman are personal ability, tactfulness, fairness, firmness, and a pleasant personality. A good way to start to build up the morale of the organization, if there are several drills operating, is to find out which drillers like each other and then put personal friends on the same drill. This method goes a long way toward preventing friction, for if there is one man in a crew that the other drillers do not like, constant friction is inevitable and the company will suffer. The driller should have the right to "turn in" his helper to the foreman if he is not satisfactory.

The driller should not be forced to work with a man who is not satisfactory to him, for it is the driller who either makes or loses money for the company.

The management should never go over the foreman's head in issuing orders to the men excepting in emergencies, for to do so is sure to undermine morale, for the men lose respect for the foreman and the foreman gets sore and will either quit or lay down on the job.

As the work expands, auxiliary forces will have to be increased. It will be found that a man and a team will be required for every three to five drills in order to handle casing and tools. This is in addition to those



TRACTION DRILL LOADED FOR SHIPMENT. BEAM AND MAST ARE REMOVED

necessary for handling fuel. An extra horse should be on hand, so that three horses may be used to a team in dragging heavy tools and casing, and also to provide a spare in case of sickness.

### Fuel and Water Considerations

In handling fuel a satisfactory method is to haul coal from the cars and store it in a stockpile at some centrally located point for distribution to the drills. This can be done either by team and wagon or by burros. Five burros can supply three drills within a radius of one-quarter of a mile. The coal is packed in boxes swung from the pack saddle, each box holding approximately 100 lb. Fuel oil also may be satisfactorily used for both firing the boiler and heating bits, the choice of fuel being dependent on relative cost and facilities for handling. A sled with iron-shod runners is used for handling casing, tools and other essential materials.

Water for the drilling of the initial hole will have to be obtained in the best and most convenient manner possible. Water usually is encountered in the course of drilling operations, and after the first hole has been drilled a string of perforated casing may be left in the hole and the hole used as a water well. A 4-hp. Fairbanks-Morse gasoline engine with pumping jack and walking beam makes an ideal pumping outfit for this class of work. The walking beam operates a single-action force pump by means of sucker rods.

Water from the well should be pumped into a main storage tank set at such an elevation that water will flow to the drills by gravity. For one drill this tank should be of 5,000-gal. capacity, and two of the same size will serve for three drills. Water is distributed to the drills by means of ¾-in. or 1-in. pipe lines, depending on the distance it is to be carried. Pipe lines should have drain cocks at low points, so that the lines may be drained during freezing weather. Four 400-gal. tanks should be situated at the drill, and these should be kept full of water at all times, so as to provide for the contingency of the main water supply being temporarily shut off. A drill will require 2,000 gal. to 2,500 gal. of water per twenty-four hours and about 3,000 lb. of coal. This is during the period that the drill is running, but consumption will average less than this on account of delays.

### Drilling Problems To Be Met

It is well to emphasize at this point, in the order of their relative importance, the problems confronting the management at the inception of operations. These are as follows: To get the holes down to, and through, the zone of mineralization; to sample accurately the ore-bearing horizon, and to accomplish the above with the minimum expenditure of time and money.

In churn drilling, one of the factors that has considerable bearing on cost, time, and methods employed is the depth to which it will be necessary to drill the holes. On a new property this is unknown, and the first hole should be drilled with the expectation of having to go at least 1,000 ft. In ordinary ground, it will be safe to start with a 12½-in. hole, using 10-in. as the first string of casing.

*Then Fight the Big Hole Down.* The importance of carrying the big hole (12½-in., 10-in., and 8¼-in.) as far as possible is not generally recognized by an inexperienced management, but it is by the experienced driller.

The reasons for carrying the big hole as far as possible are as follows:

To insure the hole reaching the desired depth; it is easier to fish out tools in the large hole than in the smaller because it is possible to use a greater assortment of fishing tools and there is more room in which to work; and ore should be reached with a hole of sufficient diameter to give a fairly large sample per foot of hole. Also, there should be a leeway of one or two strings of casing when ore is reached, so that if caves are encountered in the orebody the hole can be cased and the cave shut off to insure accuracy of samples. If possible, the 8¼-in. hole should reach the orebody and the 6¼-in. casing set on top of the ore to prevent capping caving into the hole and contaminating the samples. This leaves the 4½-in. casing for shutting off caves in the orebody itself.

In shallow deposits occurring in good drilling ground, the first holes are likely to be started and carried too large, but this is far better than the other way round. After three holes, not in the same straight line, have been drilled, the pitch of the deposit can be determined and the succeeding holes started and drilled accordingly.

### Methods of Drilling to Depth

If it is found that the hole as drilled will not reach the desired depth, several courses may be pursued, as follows:

1. Get a string of 3-in. tools and a string of 3-in. casing and continue the hole this size. By this method the hole can be driven from 100 to 150 ft. deeper in ordinary ground.

2. Pull the 4½-in., 6¼-in. and 8¼-in. casing and ream the hole, trying to get each string of casing considerably deeper than before. I do not favor this procedure, as it will be useless if each string has been "fought down" in the first place.

3. Pull the 4½-in. and 6¼-in. casing and free the 8¼ in. casing by pulling it up the hole far enough to allow all of the caved material behind it to fall into the hole, thereby freeing the casing. Then under-ream the 8¼-in.

casing, getting it down as far as possible. Do likewise with the 6¼-in. and 4½-in. casings. This method will usually be found satisfactory.

4. The use of mud-laden fluid in the course of drilling, accompanied by under-reaming. This method, borrowed from rotary practice, consists of pumping mud around the last string of casing, the mud rising to surface through the casing. The mud penetrates the loose formation, holding up the walls and preventing caving of the hole and freezing of the casing. This method necessitates special equipment as pumps, connections, and other parts.

5. The abandonment of the hole and the starting of a new one. Methods 1 and 3 are preferable. Under-reamers are not included in the list of equipment, there being no need to get them for ordinary ground. If under-reamers are necessary, extra cutters, dressing, blocks, and ratchet rope socket should be ordered also.

### Wire Line for Wet Drilling

Manila line should be used for drilling as long as possible. If the formation is dry, it may be possible to drill the entire hole with it. If the formation is wet, by the time the hole has reached a depth of 250 to 300 ft. below water level it will be necessary to use a wire line. The wire line is babbitted directly into the rope socket. This is done by heating the end of the cable to a bright red and then turning the individual strands inward and back on themselves after first running the wire line through the rope socket. The cable is then pulled tightly into the rope socket and molten babbitt poured around the cable. Care should be taken not to heat the cable in such a way that the annealed portion will extend out of the rope socket.

The drilling cable should be of ⅞-in. diameter, 6-strand, and 19 wires to the strand. I have found Leschens California Special will give excellent results. The reasons for the choice of a 6-19 cable as against a 6-7 are: The 6-19 is more springy and has more "life" in it than the 6-7; it is easier on the rig and can stand short bends better, and with its smaller diameter wires the 6-19 will show signs of approaching failure quicker than the 6-7. Breakage of drilling lines is usually caused by the line rubbing against the casing and thus wearing out, especially at a point where the line has been kinked or bent enough to give it a permanent set. The outside wires of the 6-19 will wear through before the cable is too dangerous to run. The 6-7 will not show these signs, as there are no inside wires, and when the individual wires wear thin the cable will part as a whole without showing signs of incipient failure.

Let me impress on the management that it is unreasonable and ultimately may be expensive to find fault and grumble when the drill foreman puts in a requisition for a new wire line. It is better to be on the safe side, and make sure that he doesn't run the old one too long. By running the old line a few days longer, he may get fifteen or twenty dollars' worth of extra wear out of it, but he is taking a chance on creating a fishing job that may cost from fifty dollars to the losing of a hole on which one or two thousand dollars has been spent.

### Haste Makes Waste in Removing Tools

In removing the tools from the hole, they should be hoisted slowly unless the cable is known to be in first-class condition. The driller should hold a sack around the cable, allowing the cable to pass through his hands so that any wires that may be broken will catch on the sack and indicate any point at which failure has started. If broken wires are found, the cable should be inspected, and, if the place is bad enough, it should be cut and spliced. In splicing, unlay each end to be spliced for 24 ft., making the total length of splice 48 ft. and tuck the ends until they meet. That is, each end to be tucked will be 4 ft. long.

Tools should never be run into the hole at a high velocity. Throwing back the brake and letting the tools practically fall into the hole will save little time as compared with lowering the tools at a safe and reasonable velocity, and not only does the fast lowering put an excess strain on the drum, mast, brake, and cable, but there is a good chance for the tools to get beyond control and "jump off" a pin or two when they strike bottom.

DRILL OPERATING IN 6¼-IN. HOLE, SHOWING ARRANGEMENT OF SAMPLE SPLITTER

When drilling with a wire line a wooden plug with a hole bored through the center of it should be used in the top of the casing to prevent wear of the drilling line and threads of the coupling. This plug is split in half and is hinged on one side by means of old belting to allow the plug to be placed around the cable and inserted in the casing.

In bad ground where tools are likely to stick or get hung up, it often helps to run a 4-ft. sinker above the jars and use a longer stroke jar. By having this additional weight above the jars it frequently happens that

the drilling string can be jarred out after being partly buried, when otherwise the tools would have to be fished out.

### Disadvantages of Drilling Under Caving Conditions

Another point I would emphasize is the folly of drilling ahead when the hole is caving and there is danger of getting the tools buried. For purposes of illustration, we will take the following instance: The tools are 200 ft. ahead of the casing and progress has been approximately 10 to 15 ft. per eight-hour shift. The hole begins to cave, and progress is cut down to 5 ft. per shift, which may be satisfactory from the standpoint of cost. In the ordinary course of events, either one of two things will happen; the hole will have to be cased in the next day or two, or the drilling string will get buried and a fishing job will result. It is poor business to run the risk of a fishing job for the sake of gaining 25 or 30 ft. of hole. If it is known that the hole can be finished with the remaining strings of casing, the proper thing to do is to case the hole. If it cannot be so finished, under-ream the casing and set it on bottom.

In under-reaming, the two secrets of success are keeping the casing free and thoroughly under-reaming the hole as you go. Just because the under-reamer will go down the hole considerably below the casing is no sign the casing will go. The proper thing to do is to thoroughly under-ream the hole from the bottom of the casing down, for a bump sufficient to stop the casing may not be struck by the under-reamer once in ten strokes. A ratchet pipe socket is of great aid in successful under-reaming, for when run with the proper motion it absolutely assures the proper rotation of the tools.

Bits should be kept to gage and water courses cut out. The face of the band wheel should be covered with old belting and the belt should be protected from the weather by a good belt house. If this is not done it will be impossible to run in wet weather, on account of slippage.

In drilling difficult ground, the problem changes from that of drilling a hole to one of successfully getting the necessary casing in the hole. When the hole reaches ore, the main consideration is that of obtaining reliable samples.

### Sampling a Matter of Careful Judgment

On the first hole or two, samples should be taken every five feet and assayed. After some definite information has been gained with respect to the formation, sampling may be dispensed with in the leached capping overlying the ore. When it is known that the hole is approaching the ore zone regular 5-ft. samples should be taken but not dried, five samples being kept in the tubs. As soon as the orebody is reached, the previous five samples should be dried and sent to the assay office.

A sample consists either of all or a definite proportion of all of the sludge obtained in the drilling of five feet of hole. If the hole is small all of the sludge obtained in the drilling of a 5-ft. section may go into the resulting sample. If the hole is large the sludge is put through a splitter cutting to ½, ¼, ⅛, or 1/16. (For detailed drawing of splitter see Peele's "Mining Engineer's Handbook," p. 426.) The sludge is dumped directly from the bailer into the sludge launder which runs to the splitter and the final sample is collected in a tub placed under one of the splitter outlets.

Samples for panning should be taken at 5-ft. intervals from the top of the hole down. These need not be put through the splitter, a portion from one bailerful being set aside for panning. These panning samples are for the purpose of keeping track of the different formations penetrated and minerals encountered as the drilling progresses. Panning is best done with a 12-in. white enameled vanning plaque. Formations and minerals encountered are entered on the "Daily Drill Report" by the sampler.

My experience has been that the copper minerals encountered are usually found in the following order, the first named being higher up in the formation: Chrysocolla, malachite, azurite, cuprite, native copper, chalcocite, chalcopyrite, and pyrite. Of course the occurrences of these minerals will overlap, but the order as set down is typical.

The transition from leached capping to chalcocite-bearing ground is usually abrupt, and the first indication of the chalcocite zone having been reached is the appearance on the top of the sludge in the bailer of a dull lead-gray scum composed of slimed chalcocite. An experienced driller will spot this scum as soon as he sees it.

When the chalcocite zone has been reached, the hole should be cased to insure reliability of samples. The depth of the hole should be measured so that accurate information as to the vertical position of the ore may be obtained. Samples should be taken at exact 5-ft. intervals, the hole being bailed clean after each sample. The sludge from the entire 5-ft. section is put through the splitter until the sample is of proper size to dry and send to the assay office. The dried sample should weigh approximately 75 lb. and fill an ordinary ore sack.

### Make Wash Water a Part of Sample

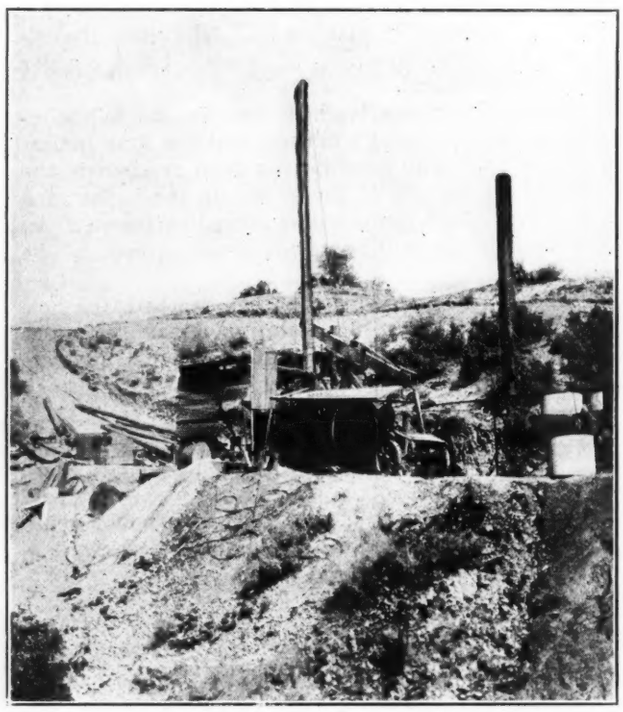
The sludge launder and splitter should be washed thoroughly after each sample and the wash water and washings treated as a component part of the sample. The water should never be poured off of a sample, but should be evaporated.

In the early application of churn drilling to the development of disseminated copper deposits, samples were dried in tubs over a coal or wood fire. This was a dirty, expensive, tedious, and unsatisfactory process. The samples frequently got red hot on the bottom, and it was no uncommon thing to smell sulphur dioxide caused by the oxidation of the sulphides present. This tended to make the sample unreliable when tested for the purpose of determining the amount of copper present in sulphide form. Also, owing to the general nastiness of this method of drying samples, the sampler was prone to slight his work. This he would do by pouring most of the water and slime off of the samples, or he would make two or more samples out of one. That is, one or more wet samples would be thrown away, and the retained one dried and divided into two or more parts. There are a great many things that go on, on "grave-yard" shift, that are unknown to the man with the "gasket around his neck."

Recently some of the operators have been using a steam drying pan and drying the samples by means of live steam obtained from the boiler of the drill rig. This pan is circular, being about 3½ ft. in diameter and about 1 ft. deep, and is constructed of boiler iron. It has a double bottom, into which live steam is turned

at full boiler pressure, the outflow of steam and rapidity of drying being regulated by means of a waste valve. The double bottom is kept from bulging by the use of stay bolts, as in boiler construction. All stay bolts and rivet heads on the inside of the pan are flush with its surface. This permits the easy cleaning of the pan by means of a scraper and wire brush. The steam drying pan is a most efficient means of drying samples and by its use, time, money, and worry are saved and the reliability of the sample is increased. After drying, it is sacked, tagged, and sent to the assay office.

The management should rigorously insist on accuracy and reliability of sampling. The drillers and drill foreman should thoroughly understand that the landscape is not being punched full of holes for mere pastime, but



PORTABLE DRILL, WITH HOUSING
Arrow at left indicates new type of steam drying pan.

for the purpose of obtaining reliable samples from a certain horizon. This is something that is extremely hard to do, for the driller has learned to think in terms of "feet of hole," and it is hard for him to change his point of view. Sampling is no concern of his, for is he not employed to "dig holes"? The proper perspective is obtained when costs are thrown into terms of "cost per sample" instead of "cost per foot of hole."

Take the following illustration as an example: Suppose the total cost of drilling a 1,000-ft. hole is $3,500 and the ore is 100 ft. in thickness. In 100 ft. there are twenty 5-ft. samples. The cost per foot of hole is $3.50, but the cost per sample is $175. Therefore, should not particular pains be taken to insure reliability of samples from a cost standpoint alone, to say nothing of the more important functions of the samples; *i.e.*, their bearing on the grade of the orebody?

On the 200-ft. square system, one hole controls 40,000 sq.ft. If the ore is 100 ft. thick, twenty samples control 320,000 tons of ore, and one sample controls 16,000 tons. A variation of 0.1 per cent *in one sample* with copper selling at 12½c. per lb. denotes a variation of $4,000 in the value of the orebody.

When the hole begins to show signs of caving, either a new string of casing should be put in, or the string above should be lowered, either by under-reaming or driving, so as to shut off the cave.

If there is water in the hole, as is usually the condition, before the bailer is run for samples water should be run into the hole so as to have the hydrostatic head inside the casing greater than that on the outside. This tends to prevent the water from washing material from around the casing into the hole. In fact, in many instances I have found it advantageous to keep water running into the hole at all times, for the water passing up around the casing tends to keep the rock particles from settling around the casing and freezing it in.

*To Be Continued.*

## Sintering of Flotation Concentrates

In *Engineering and Mining Journal* of June 11 was described the plant of the Calaveras Copper Co., where flotation concentrates are sintered to prepare them for charging to blast furnace. The same practice is followed at the Mount Lyell plant, in Tasmania, and the practice is described in the *Proceedings* of the Australasian Institute of Mining and Metallurgy, No. 38.

A Dwight-Lloyd machine is used, of the following specifications:

Grate area, 300 x 30 in.
Grate speed, 15 in. per minute.
Vacuum in suction boxes, 12 in. of water.
Ignition, wood burned in standard ignition box.
Impeller, 5 ft. 6 in. diameter, 900 r.p.m.
Horsepower, 50.
Intake, 4 x 4 ft.
Outlet, 3 ft. 1 in. x 2 ft. 1 in.

The charge to the machine averages 60 per cent concentrates, 30 per cent blast furnace flue dust, and 10 per cent ore screenings, and contains 11 per cent moisture. The sulphur contents of the charge average 19 per cent, and the sinter, 6 per cent. The capacity is 50 to 55 tons of the mixture per twenty-four hours, the sulphides being in the form of chalcopyrite and pyrite chiefly.

A nodulizing kiln, fired with pulverized coal, has also been erected but not yet put into operation, on account of shortage in coal.

## World's Largest Deposit of Rock Salt

In New York, Ohio, Michigan, Pennsylvania, West Virginia, and other states there are large salt deposits, but the largest deposit in the United States, and probably in the world, is that which extends from northern Kansas across the west end of Oklahoma, the panhandle of Texas, and southeastern New Mexico to western Texas. The area underlain by these great Permian salt deposits is not far from 100,000 square miles, according to the U. S. Geological Survey.

The limits of the deposit, especially to the northwest and southeast, have not been ascertained, but in general the area of thick salt extends fully 650 miles from northeast to southwest, and is 50 to 150 miles wide. The thickness and the succession of the beds are variable, but 700 ft. is reported in one hole, and in many places the aggregate is more than 300 ft. On the assumption of an average thickness of 200 ft. of salt, the gross quantity in the area of 100,000 square miles is so large, about 30,000 billion tons, that the present needs of the United States (about 7,000,000 tons a year) can be supplied for millions of years.

# The Crahall Tailing Plant

## Re-Treating 200,000 Tons of Tailings Assaying 1.75 Per Cent Zinc Necessitated Great Economy of Construction and Operation —Recovery by Drag Bucket, and Concentration Solely in Jigs

BY W. F. BOERICKE
Written for *Engineering and Mining Journal*

DURING 1920 a number of attempts were made to remill the tailing piles in the New Diggings area of the Wisconsin zinc field. Labor for the mines was scarce and inefficient, and some of the operators, instead of trying to mine, held their organizations

GENERAL VIEW OF THE MILL

together by running on tailings alone. In some cases the original mills were utilized by making small changes in the flow sheet; in others a cheaply constructed, temporary plant was built adjacent to the tailing pile. Of such a type was the mill erected to treat the tailing pile of the old Crahall mine, estimated to contain over 200,000 tons.

The material to be milled, hereafter to be called the heads, consisted of mill chats (tailings), which had been lying undisturbed for seven years, and were now in an extremely compact, almost cemented formation. The loose, spongy character of many of the Joplin tailing piles was entirely lacking, owing to the fact that in the original milling work no attempt had ever been made to deslime the tailings, and the included fines therefore made a compact mass that would stand almost perpendicularly without caving when cut.

Before construction was undertaken, the pile was sampled at various points on the surface by means of shallow test pits. Although this sampling was superficial, it was assumed from a knowledge of the mine's production and history that such samples would give a fair indication of the interior of the pile, and this conclusion was justified by subsequent work. An effort was made, of course, to avoid sampling at any point of obvious concentration that was due to weathering.

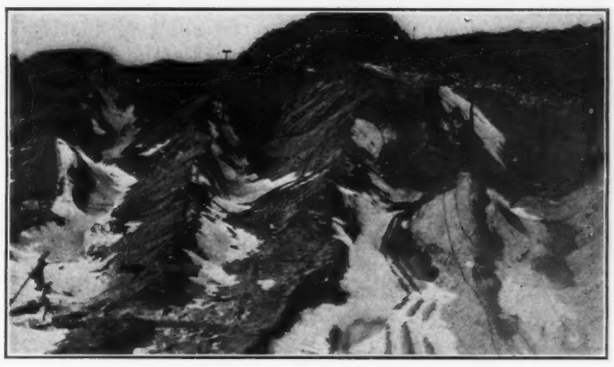
SCREEN ANALYSES OF THE HEADS

| | Weight, Per Cent | Cumulative Weight, Per Cent | Zn Content, Per Cent |
|---|---|---|---|
| On 4 mesh | 28.0 | 28.0 | 0.4 |
| On 8 mesh | 28.0 | 56.0 | 1@2 |
| On 16 mesh | 16.0 | 72.0 | 1@2 |
| On 28 mesh | 9.5 | 81.5 | 2@3 |
| On 48 mesh | 12.5 | 94.0 | 3@4 |
| On 65 mesh | 2.0 | 96.0 | 3@4 |
| Through 65 mesh | 4.0 | 100.0 | 3@4 |

Assays of general samples varied between 1.3 and 2.0 per cent Zn. The minus-4-mesh material, comprising 72 per cent by weight of the heads, assayed 2.1 per cent Zn. This suggested that an improvement could be made by screening out the oversize, which carried negligible values. Careful examination of the zinc in the undersize showed that only a small proportion was combined with gangue. This indicated that regrinding would not be necessary, and the ore was practically free-milling.

As the mill was to be short-lived, and as its entire cost had to be amortized during the life of the pile, which was estimated at three years, there was no need for elaborate construction. A plank jig, constructed of 2 x 12-in. timbers laid edgewise between frames of 4 x 6's, properly bound together with tierods and buckstays, offered a substantial saving in lumber, and promised to be as permanent as needed. It could be put together without skilled labor or supervision, and the actual erection took only six weeks. This included the building of all elevators, and placing of pulleys and line shafting. The general layout is shown in Fig. 1.

With practically all of the values in the less-than-1-mm. size, it was evident that to make a separation by simple jigging would not be easy, and it was realized



CLOSE-UP VIEW OF THE CUTS

that there would be a considerable loss in the slimes which could not be saved except on tables or by flotation. Except for the fact that the zinc was practically all free, it would have been impossible to go ahead without a prohibitive cost in more elaborate equipment, which was not justified.

As the original concentrates from the Crahall averaged between 45 and 50 per cent zinc, it was anticipated that the concentrates from the tailings would run about the same, but considerably higher in lime. As there was a penalty on every per cent of lime above 3, it was decided to build two jigs—a rougher to make a low-grade concentrate, which should run about 15 per cent Zn, and a small cleaner to make the finished product. In this way a heavy suction stroke could be used on the rougher to pull the very fine particles of zinc, and the lime that would come down with it could be removed on the cleaner.

Fig. 1 shows the plant layout, and the flow sheet is given in Fig. 2. The rougher consisted of six 30 x 40-in. cells, and the cleaner of four 24 x 34-in. cells. Settling boxes, the same size as the cells, were provided at each end of the jigs to dewater the tailings. Most of the water was saved and run into settling tanks outside the mill, and thence to the pond.

Possibly the most interesting point in the design was driving the cleaner jig and elevators direct from the jig shaft on the rougher, without using the customary lineshaft to the motor. This was made possible by mounting a 6-ft. pulley on the end of the rougher jig shaft, and using an outside bearing support, so obtaining the proper reduction in speed. This arrangement eliminated a lot of construction work and extra belts, and proved satisfactory.

The most serious trouble found in the construction after six months' operation was in the "panting" of the rougher jig. Extra timbers bolted across the ends, and extra tierods, eliminated this particular trouble.

With the heavy unclassified feed to the rougher it was found after some experimenting that a speed of 145 r.p.m. gave the best results. A long stroke was needed to loosen up the beds, accompanied by a large quantity of back water. Most of the work of the jig had to be done in the first three cells, before the rush of the top water over the tailings toward the end of the jig had so accelerated the material that it became difficult to make any separation. The taps on all cells were left open slightly, so there was a constant stream of concentrate being drawn off as a feed for the cleaner.

Six-inch beds were used on the rougher, with a bottom layer of coarse concentrates. The drop between the cells was two inches. Not enough coarse concentrates were accumulated during the shift to justify a gate and dam draw-off, but at intervals the beds were lightened by shoveling off with a short-handled shovel. When to do this depended on the millman's judgment.

With the heavy feed, large amount of water, and unclassified product, a considerable loss in fines was bound to occur. In attempting to obviate this the hutch of the last cell was drawn freely, and the bed carried very thin. The limy middling product from this cell was returned to the feed elevator to go through the cycle again.

Little trouble was experienced with the cleaner jig, and it did consistently good work. The jig was run at 155 r.p.m. with a very light stroke, much back

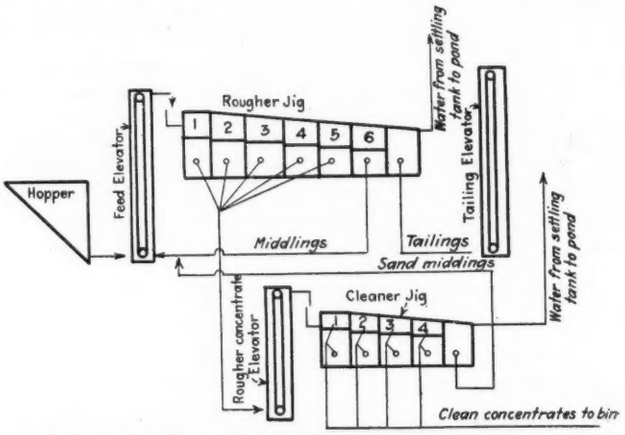



FIG. 2. FLOW SHEET OF THE CRAHALL PLANT

water, and as little top water as possible, so as to almost neutralize the suction, and make a pulsion jig out of it. The cleaner had the advantage of running on a much more closely sized product than the rougher, and in the first two cells made very clean concentrates, assaying less than 2.5 per cent CaO. The last two cells were run with a heavier stroke and less back water, to catch the last particles of zinc, though they included fine lime and middlings.

The speed of the cleaner, 155 r.p.m., may seem too low in comparison with the speed of sand jigs generally, which average around 200. A higher speed was tried, but apparently did not work out as well as the other, and this was the experience of other operators.

The mill was run on two twelve-hour shifts, to take advantage of the short season, as it was impossible to operate in winter, on account of the tailings being frozen. The actual running time, however, did not exceed seventeen or eighteen hours on the average. With so light a construction, it was inevitable that time would be lost. The low grade of the heads, yielding only 2.0 per cent of their weight in concentrates, made the margin of profit very narrow. Only competent millmen were employed, and it was a constant struggle with them to get the beds right, so as to make the best recovery. With the zinc all in the fines, if too heavy a suction were used on the rougher, the beds would mat and the screens bind, ruining the work. If not enough suction, all the fine zinc would be carried off in the tailings. If the feed came too fast, the jig became sluggish and simply served as a launder; and if the feed slowed up there was no recovery. A sudden rush of

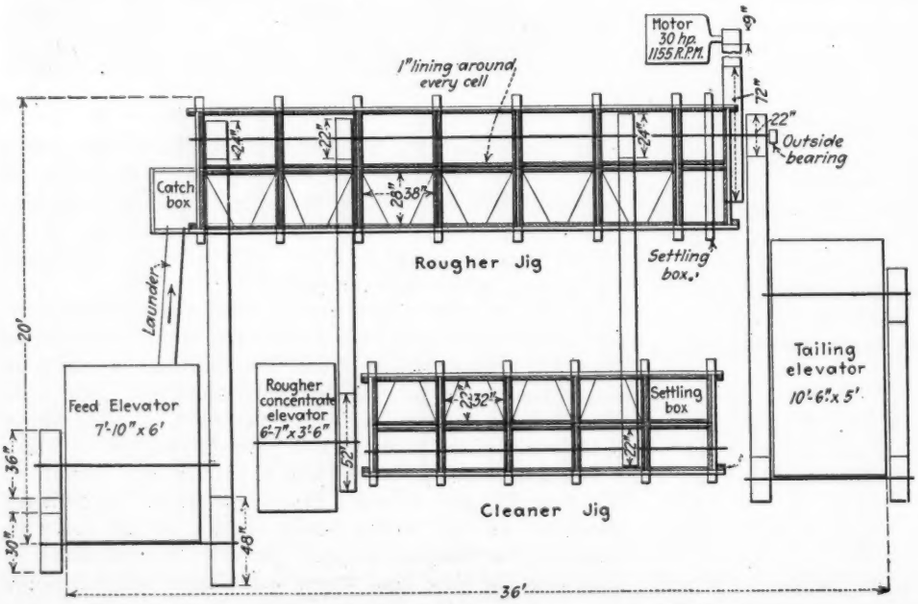



FIG. 1. LAYOUT OF CRAHALL TAILING MILL

tailings was likely to bury the tailing elevator and cause an hour's shutdown while the boot was dug out.

No exact figures on the tonnage actually handled per day are available, but 225 tons is not far off, which is at the rate of fourteen tons per hour. The crew consisted of two men, the millman and the hoistman, who operated the drag and in case of trouble acted as mill backer. A third man was often needed for repairing, shooting tailings, and other general work.

Power was furnished by a 30-hp. induction motor. Separate motors were used for the hoist, booster, and pumps. Of the 30 hp. needed for the mill, a large proportion went into the tailing elevator, which was 50 ft. high.

The mill recovery is worth noting as showing what can be done with jigs on a low-grade feed, with all of the zinc in the fines. A screen analysis of the concentrates shows:

| | | Opening, Mm. | Per Cent | Cumulative, Per Cent |
|---|---|---|---|---|
| On | 10 mesh | 1.65 | 25.8 | 25.8 |
| On | 20 mesh | 0.83 | 23.3 | 49.1 |
| On | 48 mesh | 0.29 | 35.0 | 84.1 |
| On | 65 mesh | 0.21 | 7.5 | 91.6 |
| On | 100 mesh | 0.15 | 5.0 | 96.6 |
| Through | 100 mesh | .... | 3.4 | 100.0 |

In other words, of the total zinc recovered about 60 per cent was in the minus-1-mm. sizes, which should normally go to a table. The average heads ran 1.75 per cent Zn, and the tailings 0.6 per cent Zn. Of the tailings, the plus-10 mesh, comprising 32 per cent by weight, assayed 0.4 per cent Zn, and the minus-10 mesh, 68 per cent by weight, 0.95 per cent Zn. The slimes, lost in the settling tanks, ran 8 per cent Zn. All of this latter material was less than 40 mesh.

The recovery may be calculated as follows, the weights being approximate:

| | |
|---|---|
| Tons milled per day | 220 |
| Assay heads, per cent Zn | 1.75 |
| Zinc in heads, per day, tons | 3.85 |
| Concentrates recovered, tons | 4.5 |
| Grade of concentrates, per cent Zn | 48 |
| Zinc in concentrates, tons | 2.16 |
| Recovery, per cent | 56 |

This compares with the normal mill recovery in Wisconsin of 65 per cent when running on 6 to 7 per cent mill feed. Undoubtedly the recovery could have been much improved had tables been installed to treat the fines that were simply lost, but as an extra man would have been needed, and the added installation expense would have been considerable, the net saving is questionable.

### JIGS NOT EFFICIENT ON MINUS-20-MESH FEED

Screen tests of concentrates made at a number of mills in the district which were running on 6 per cent ore and crushing through ⅜ in. showed that 75 to 80 per cent of the concentrates were coarser than 20 mesh. As the recovery in this case was 65 to 70 per cent, the conclusion follows that jigs are more efficient on sizes coarser than 20 mesh than on finer sizes, but they can, at a pinch, make a fair saving on fine material when no better means are at hand.

Fully as important as the milling was the problem of getting the heads to the mill at low cost. Any system of shoveling in cars, or using horse and scrapers, was dismissed at the start as being too expensive, even if an adequate tonnage could be obtained in the hot summer months with labor scarce and inefficient. As alternatives, there was the choice of sluicing in the heads to the mill with water, or using a hoist and drag system. Both of these were tried. At the outset, as the mill was close to the base of the pile, sluicing was attempted. The boot of the feed elevator was sunk 10 ft. below the ground level, and a sluiceway was dug up to the tailing pile, with a pitch of three inches to the foot. Water was run up to the pile, and the tailings were washed down by undercutting. It was found that nozzles on the hose were of little benefit; volume of water was needed, not head. The practical difficulty lay in adjusting the right amount of water. If too little were used, the tailings would not run, but would choke up in the launders and overflow. If too much water, then the elevators would choke, and the jigs would have so much top-water that the fine ore would be carried away.

It was soon seen that the natural slope of the ground would not suffice to carry the tailings to the mill, even though the slope were theoretically steep enough to carry the material. Consequently, ditches were dug in the soil, and launders, with cast-iron half-moon troughing, were put in. The slope necessary was 2½ in. to the foot. It was hoped that the included slimes in the heads would make the material flow on an easier grade, but it would not. About 400 to 500 gal. of water per minute was needed.

As the distance from the pile increased, there was more trouble. The grade rose so sharply that it was impossible to keep the launders on the bottom, and once they were set on the tailing pile, the whole area acted as a big concentrating table. The heavier particles would settle, and only the lighter ones get into the launders. This meant following the ore down with the hose, or "taking up bottom," and created much trouble on the jigs, as the feed would vary so much from hour to hour that it was difficult to keep the beds. With a longer distance to sluice, moreover, it became increasingly difficult to maintain a steady feed to the jigs. The scheme was finally abandoned.

### ADVANTAGES AND DISADVANTAGES OF SLUICING

Sluicing has of course many obvious advantages. It is foolproof, and requires no expensive installation that must be amortized from the profits of a short operation. Water is needed for the mill anyway, and it requires very little more power to introduce it by sluicing. Unskilled labor can handle the job—a boy is quite as handy as a man. Where the necessary grade can be obtained with plenty of water, it is by all odds the cheapest way of moving tailings. An excess of water could be removed from the tailings by dewatering from the catchbox. But where plenty of grade or sufficient water is lacking, the scheme leads to trouble, and will slow up the milling by giving irregular feed and too great a variation in the values.

The hoist and drag system consists of a double-drum hoist on a movable platform, which can be shifted for about thirty degrees of arc, so as to pull from more than one angle. A cable is passed from one drum to the drag, or scraper, thence around a sheave set out on the pile, about 300 ft. distant, and then back to the other drum. A 35-hp. induction motor, geared to a countershaft, furnishes power. Friction clutches are on both drums, so the motor runs continuously, and the hoist is reversed by operating the clutches. The hoist had a speed of 228 ft. per minute. Cable ⅜ in. in diameter was used. Double drums are necessary to take care of the slack line.

The drag consists of a 5-ft. bottomless scraper, with

slightly flared sides, and a notched back to cut into and break down the tailings. It should be strongly built, for it has to stand rough usage. In this case it was built of ⅜-in. iron, reinforced by ⅝-in. straps, and could have been advantageously built of stronger material. Its capacity was estimated at 1,000 lb., or nearly ½ cu.yd. of tailings.

### Apparatus Removes Large Amounts of Material Per Shift

A bin, or hopper, is constructed about 16 ft. square, and 10 ft. deep. Across the top a grizzly is built of old rail, with the ends bent down, so the drag may ride over them. As these rails must be moved parallel to the line of pull when a new cut is made, they should not be fastened permanently to the caps. With this apparatus and an experienced hoistman, a great amount of material can be moved in a shift, from a maximum distance of 250 ft. The illustration shows the condition of the tailing pile after three months' operation with the drag.

The amount that can be pulled in by the drag will vary directly with the distance of the cut from the hoist, assuming that the dragway is in good condition and a full load can be taken from all points. A maximum of 300 trips in ten hours is theoretically possible from 250 ft., at a speed of 250 ft., and if the distance is halved, the number of trips is doubled. There is no time lost in dumping the load, as the drag is pulled clear up on the grizzly, the tailings are dropped through, and the hoist is immediately reversed.

During September, in twenty-six working days, a total of 11,461 loads were pulled, at the average of 220 tons per day. The maximum pulled in any one shift was 406 loads. The average distance from hoist to cut was 200 ft. The cost of dragging may be figured without allowance for repairs or depreciation as:

| | |
|---|---|
| Labor, two hoistmen, @ $6 | $12.00 |
| Power, 600 kw.-hr. @ 3c | 18.00 |
| Total | $30.00 |

Tons pulled, 220
Cost per ton, 13.6c.

With a shorter haul and consequently greater tonnage, this could be cut to less than 8c. per ton. It will be noted that power is figured at a high rate.

### Method of Removing the Cemented Material

Mention has already been made that the Wisconsin tailing piles are cemented together, owing to the sands and slimes not having been screened out, as in Joplin. This results in giving the piles a compactness that takes considerable power to break down. The problem is in no sense like moving a sand bank. For this reason the back of the drag is notched, to grip and tear down the walls of the tailings, and a bottom is not wanted. Frequently the walls of the cut will be almost perpendicular for 20 or 30 ft. In such a case the walls must be shot down with powder. Holes are bored with an auger, and a light charge of 40 per cent dynamite is inserted. Some experimenting was done with a lower-grade powder, but it did not seem to work as well.

Instead of shooting down the walls, a snatchblock can be used on the cable between the sheave and the drag. It is anchored at right angles to the line of pull, and by varying the distance the drag can be made to take new cuts off one side or the other. When the cut is so wide that the angle between the two cables is appreciable, and friction and power largely increased, the sheave must be taken up and moved up to a new location and a new cut started. This takes time, as the sheave must be anchored firmly. If the new location makes a considerable angle with the old, the rails on the hopper must be taken up and relaid.

Despite every effort to place the cuts to good advantage, it will be impossible to clean up the ground completely. Ridges will be left between the cuts, and though the size and height of these may be reduced by shooting down and swinging the drag with a snatchblock, a considerable proportion will be left. A close-up of the cuts, with the ridges between, is shown in the illustration. It does not pay to come back after these. In the first place, the tonnage remaining will not warrant much expense; in the second, there would be much difficulty in starting a cut on a narrow ridge, as the drag will slide off on either side and spill the load.

### Use of Drag Necessitates Shooting Out Stumps and Boulders

Among the practical difficulties found in operating a drag, the most grief comes from meeting obstacles in the tailing pile that are covered up. Where the original tailings were run on the side of a hill or stacked with an elevator, trees, stumps, and other objects or materials are frequently covered up, and only discovered later as the cut is made. These must be shot out or cut out, either process being a mean job, which delays the work. Boulders are another nuisance—if met unexpectedly they may break a cable or badly damage the drag before the hoist can be stopped. Among other things to try the heart of the hoistman is the danger of caves when the cut is deep and the walls are high. It frequently happens that a rush of tailings will bury the drag completely and necessitate a lot of work to dig it out.

With all its disadvantages, however, the drag when properly operated under the right conditions has much to recommend it. It is a simple, positive method of getting material to the mill. Barring accidents, there is nothing to get out of order, and repairs can usually be made right on the spot. It is not affected by weather conditions. Its capacity is entirely adequate for a small mill. Finally, in case of a mill shutdown it can be operated without stop until the hopper is full, thus giving the mill a reserve capacity—a feature impossible with sluicing. The salvage value of the outfit is considerable.

OPERATING COSTS OF MILL AND HOIST PER 24-HOUR DAY

| Dragging tailings to mill: | Amount | Per Ton Tailings |
|---|---|---|
| Labor, two hoistmen @ $6 | $12.00 | ..... |
| Power | 18.00 | ..... |
| Total | $30.00 | 13.6c. |
| Milling: | | |
| Labor, two millmen @ $6 | $12.00 | ..... |
| One helper @ $5 | 5.00 | ..... |
| Power | 19.00 | ..... |
| Total | $36.00 | 16.3c. |
| Superintendence | 5.00 | 2.3c. |
| Total | $71.00 | 32.2c. |

With a milling ratio of 1:50 the cost of concentrates was $16.10 per ton. To this figure should be added repairs and amortization of plant. It is obvious that with the zinc market prevailing at the end of 1920 it was impossible to operate except at a loss, but under normal prices and advantageous operating conditions there is a fair margin of profit.

# By The Way

## A Lead Devil

The Old Boy was doubtless the patron saint of smeltermen in a more superstitious, less intelligent age. This probably accounts for the half-aspirated prayers that even now fall upon and shock the pious ear occasionally when something about the charge goes wrong. Oft-times a smelter veritably looks at night like hell, so much so that Dante would feel in familiar surroundings. One is not startled then, even on Friday the thirteenth, when he comes across a bit of metal, grotesquely shaped, like that shown in the accompanying illustration. This "devil" was accidentally formed when a sample of lead was poured on an iron plate. The figure is about 8 in. high and a quarter-inch thick and will do very well as an idol for the profane at the plant in Newark where it had its origin.

THE LEAD DEVIL

## The Green Goddess

Mining engineers must not fail to see "The Green Goddess" the next time they come to New York. First register at the Institute and pay those dues, incidentally; then ho! for the nearest taxi and the verdure-hued divinity. We hope this notice will do some good, because the producer has offered us two tickets for the publicity and we want him to get his money's worth. Mr. Winthrop Ames also sent a little blurb about the leading man, but of course we can't run anything of the sort in our editorial pages. It pains us even to think of it. We are trying very hard to be ethical nowadays.

## Opportunity Knocks

Only the present business depression and the general all-around rottenness of the market prevent us from getting in touch with the writer of the following letter, which is translated from the French. It was received in the Paris office of a large American machinery house:

I have just learned that you do core drill prospecting in all countries of the world, and inasmuch as I also am engaged in searching for mines, I address you with the sole aim of communicating to you my proposition.

I possess a silver-lead mine on which work has ceased due to lack of capital necessary to arrive at the exploitation stage. The preliminary work has given good results. An analysis has shown 45 to 50 per cent lead, 25 to 27 per cent silver, and 10 per cent copper.

For this mine, I am willing to associate myself with your company or I will sell the mine with the provision that I direct the mine works and for a royalty per ton. If necessary, I am willing to cede my rights to all my other mining properties according to the terms of the contract concluded between your company and myself. And I shall provide you with all useful information to put the mine into operation from the point of view of exploitation. A capital of 100,000 fr. is needed. The mine is well situated. The entries pass under the right of way of the Paris-Lyon-Mediterannée railway and under a road only three kilometers distant from a railway station. The veins are heavy, varying from one to three meters thick for an established distance of several kilometers.

I have also discovered in the same district other deposits such as coal, silver-lead, gold-bearing quartz interlaid with antimony. The vein is 1m.80 wide and has been traced for 400 meters. You will please advise me if these affairs interest you.

I am very loyal in business. In fact, I believe that enterprises of this sort can succeed and conserve for a long time their success only if they rest on a condition of honesty and absolute frankness.

In consequence, I give you the best guarantee that my teaching is as I have outlined, the most precious for you. You certainly are convinced that I would not promise this were I not absolutely sure that my prospects are such as I have described them to you.

After all is said and done, human nature *is* the same all the world over.

## Goin' h'On Shif'

BY D. E. A. CHARLTON

W'en thee wakes tha sun is streamin' in tha winnow, an' tha gleamin'
O' tha dewdrops as they glisten in tha grass
Makes tha worl' look snug an' fitty, an' thee naws that it's a pity
If thee lies there 'stead o' startin' in thy task.

So thee jumps h'up in a 'urry, puts tha clothes h'on in a flurry,
An' gaws daown to 'ave some 'am an' h'eggs an' tea.
There's tha missus, neat an' tidy, with a laugh she stops to chide 'ee
For she's wish'd for fear that late to work thee'd be.

Then thee finishes tha h'eatin', sez good-bye, an' starts a-meetin'
O' tha chaps 'oo's travelin' long tha road with thee.
"Moornin' Jan, an' Bill, an' 'Arry. 'Ow's gettin' on." They carry
H'each 'is bucket full o' pasty an' o' tea.

There's a good-sized crowd a-waitin,' 'oo is askin' for a ratin'
An' 'oo's 'opin' that they'll lan' some kin' o' job,
W'ile tha chaps 'oo's workin' steady, in tha dry-'ouse gettin' ready,
Is discussin' differen' ways o' cavin' gob.

'Fore tha w'istle starts a-blawin', mos' tha boys is dressed an' jawin'
An' a-walkin' with tha shifters to the shaf',
There we lines h'up on tha cages, an' gaws daown by easy stages—
But that day's work, son, is not commenced by 'alf.

W'en we reach tha bloody station, there's tha nipper jus' a-pacin',
An' a-passin' h'out the newly sharpened steel.
Then h'each contrac' starts a-makin' for their place, an' soon a shakin'
O' tha drills is 'eard—an' work is h'on, you feel.

# CONSULTATION

## The Metallurgy of Tungsten

"Will you kindly tell me whether tungsten is used very much in the metallic state and for what purposes? I would also like to know briefly how tungsten is reduced to the metallic form from its ores?"

Tungsten metal is used in the well-known tungsten lamp filaments, for targets and cathodes in X-ray tubes, for electric contacts for the make and break of magnetos, and for induction coils. Its greatest application, however, is as an alloy in the manufacture of high-speed steel and machine parts. The insistent demand for tungsten in ferro-alloy manufacture during the war led to extraordinary increases in price and greatly stimulated tungsten production in the United States. At present, owing to the quietness of the ferro-alloy industry and the low prices of foreign ores, tungsten mining in the United States is dormant.

Tungsten metal is usually obtained from wolframite (FeMn) $WO_4$, by thoroughly mixing the mineral, after it has been ground in a ball mill, with sodium carbonate (a small amount of sodium nitrate may be used), care being taken that the soda is in excess of the $WO_3$ content of the ore. This mixture is roasted in a gas-fired reverberatory furnace at a temperature of about 800 deg. C., the consequence of this operation being the formation of a pasty mass, sodium tungstate, covering the bottom of the furnace. This sodium tungstate is raked out while hot, and after cooling is finely crushed.

The next step in the process is to get the sodium tungstate in solution by agitating it in a vat with hot water and filtering the solution. The clear liquid is then heated to a boiling temperature and calcium tungstate precipitated by treating it with calcium chloride, $CaCl_2$. Washing the white precipitate and boiling with hydrochloric acid yields tungstic acid, $H_2WO_4$, a yellow precipitate. Although usually of high purity at this stage of the process, it is brought to a higher degree by boiling with a solution of ammonium hydroxide, to give, after filtration, a clear solution of ammonium-paratungstate. This solution is evaporated, and the residue treated with nitric acid to form the yellow tungstic acid. Repetition of this refining step may be necessary to obtain a sufficiently pure product.

The next stage is to fire the tungstic acid in silica crucibles at about 1,000 deg. C., driving off the water. Impurities remaining in the product may be iron, aluminum, and calcium oxides. The $WO_3$, oxide of tungsten, remaining after this operation is reduced in a closed furnace, heated to about 1,200 deg. C., through which a continuous flow of pure hydrogen is passed. The process leaves pure tungsten in the form of a dark gray, finely crystalline powder, stable under normal conditions, which is removed from the furnace after about seven hours' treatment and pressed in special disks under hydraulic pressure. The metal crystals adhere together to form a bar. The pressed bar is then heated in a special furnace supplied with an atmosphere of hydrogen, to prevent metal oxidation, to about 3,000 deg. C., giving a heavy, silvery metal, hard and brittle. R. M. Keeney has estimated that probably half the consumption of tungsten in alloy steel is used in the form of ferrotungsten, the remainder being tungsten metal. The U. S. Geological Survey states that the ratio has changed, and that now about three-fourths of the tungsten used is introduced into steel as ferrotungsten, because of the purer form in which ferrotungsten is manufactured and because, for a time, the powder could not be obtained.

Ferrotungsten is generally made in an electric furnace and has a high density and fine gray fracture, and is not crystalline. The metallurgy is simple, including the reduction of the ore with carbon as a reducing agent and a subsequent refining and decarburization, details of which can be found in a paper in Vol. LXII of the *Transactions* of the American Institute of Mining and Metallurgical Engineers, "Manufacture of Ferro-alloys in the Electric Furnace," by R. M. Keeney. It is described as being a ferro-alloy easy to manufacture, except for the fact that it must be made in a knock-down furnace. At one time tungsten ores were put in the charge and the tungsten was alloyed directly with the steel, the original method of manufacturing tungsten steels, but because impurities were introduced into the finished product by this arrangement, the method was not continued.

No definite schedule of specifications for tungsten ore seems to exist, transactions being consummated according to the different requirements of individuals. During the war all grades of tungsten ore were used, and although the demand was first for ores of high concentration and purity, it gradually gave way to the use of low-grade and impure material. One firm is reported by the U. S. Geological Survey to have been organized specifically for the purpose of purchasing ores carrying less than 60 per cent $WO_3$ and ores containing sulphur, copper, arsenic, bismuth, tin, antimony, phosphorus or other impurities, to which most users objected. Another company was organized to handle tailings carrying as little as 1 per cent $WO_3$.

The prices of tungsten concentrates are so low that the entire tungsten industry in the United States is at a standstill. Because of the high cost of mining domestic deposits, compared with the cheap foreign mining, the industry can thrive only under stress of war and an exceptionally high tariff. Consumption prior to the war in the United States was between 3,000 and 4,000 tons annually of concentrates carrying 60 per cent of $WO_3$. During the war it jumped to 10,525 tons (1918), and during 1921 it will be very low, because of the general industrial inactivity and slack demand for most metal products.

For further details the reader is referred to Bulletin No. 12 of the South Dakota School of Mines, "The Occurrence, Chemistry, Metallurgy and Uses of Tungsten," by Runner and Hartman; the March-April, 1921, issue of *The South African Journal of Industries*, containing an article "The Manufacture and Uses of Tungsten," by W. E. John, and the annual publications on tungsten in the volume *Mineral Resources*, of the U. S. Geological Survey.

# HANDY KNOWLEDGE

## Trimming a Steel Smokestack

BY H. H. HUNNER

Written for *Engineering and Mining Journal*

A heavy windstorm developed a breach in a 48-in. x 100-ft. steel stack 70 ft. from the base. As the boiler plant was no longer to be used except for steam heating, it was decided to cut the stack off at the break. The stack was fitted with a stationary ladder of ¼ x 2-in. strap, which was all that had saved the top 30 ft. from tearing off.

As two buildings stood close to the base of the stack, and as men were daily employed in them, the first quiet day was decided upon as an opportune occasion on which to do the work. A U-hook of ⅝-in. round iron, with an eye for 1-in. rope at one end, was dropped over the top of the stack. The lower end of the rope was strung through a snatch block at the base of a tree and tied to a locomotive.

Three strands, about 40 ft., of wrapped cordeau were slipped around the stack just above the horizontal joint at the 70-ft. break, the last strand having previously been threaded through 1-in. powder about every 2 ft. and the cartridge tied to the wrapped cordeau. A half stick of 1¼-in. powder was tied on each side of the ladder and connected with the other explosives. A battery was used to fire the shot. The locomotive engineer was signaled to open the throttle wide and the shot was fired a second or two later. Five sections of the stack landed about 30 ft. from the base of the stack..

The section just above the shot stayed hanging at the intersection of the horizontal and vertical joints. The hook was fastened to this and the rope put under tension. Two sticks of powder finished the job and left the stack in condition for future use.

## Power Required in Gold Dredging

Written for *Engineering and Mining Journal*

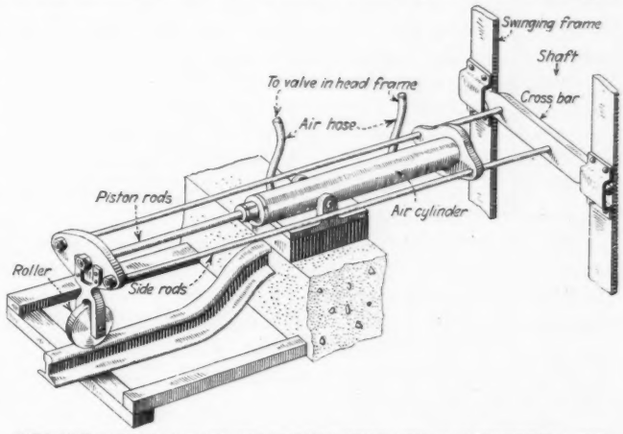
In the dredging of over 43,000,000 cu.yd. of gold-bearing gravel in 1920 in California, the consumption of power was slightly in excess of 63,000,000 kw.-hr. The average power required for dredging operations was 1.465 kw.-hr. per cu.yd. In one large operation, power averaged 1.36 kw.-hr. and in another of similar magnitude, 1.54 kw.-hr. These figures are for large dredges operating under favorable conditions.

## Changing Skips at the Plymouth Mine

Written for *Engineering and Mining Journal*

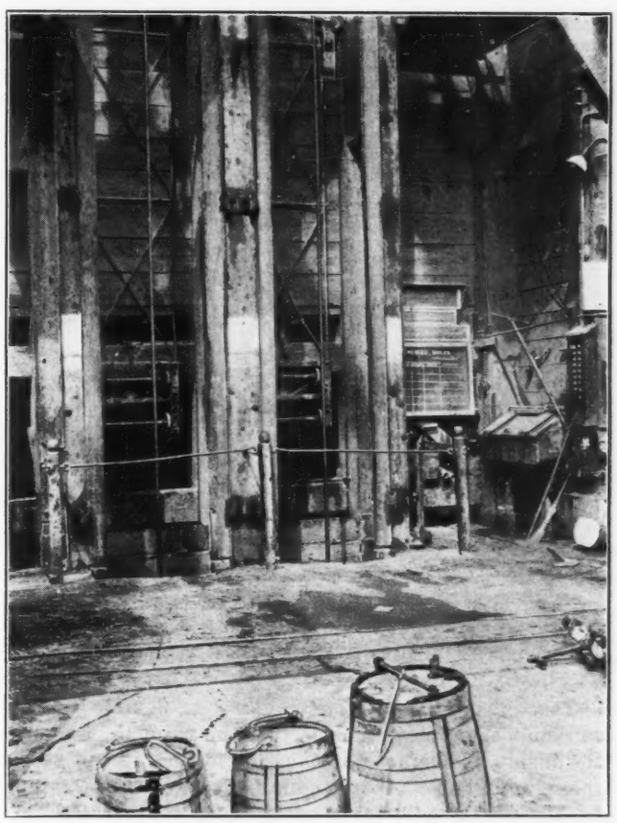
At the working shaft of the Plymouth Consolidated Gold Mines, Ltd., at Plymouth, Cal., ore skips, man cages, and timber skips are in use. To change from one to the other with a minimum of time a convenient method has been devised. Back of each hoisting compartment a light steel frame, suspended from a transverse shaft at its upper end, is placed. On the lower part of the frame are four small wheels, as shown in the accompanying illustration.

The lower cross bar of the frame is attached to two rods which at their other extremities are attached to a crosshead. The crosshead is attached to a piston rod and piston operated by an air cylinder. The air cylinder is suspended on trunnions, and part of the weight of the side bars is carried by a small wheel attached to the crosshead. The wheel travels upon a short length




DEVICE USED AT PLYMOUTH MINE, IN CALIFORNIA, TO FACILITATE CHANGING SKIPS

of track supported by cross pieces. The arrangement is shown by the sketch. The stroke of the cylinder is approximately five feet and it is operated by compressed



SWINGING FRAMES, INDICATED IN ACCOMPANYING SKETCH, IN PLACE IN HOISTING COMPARTMENTS

air. The valve for its operation is on the platform upon which the operator who changes the skips stands. The cylinder and its accompanying gear are beneath the ore pocket and away from the shaft.

When it is desired to change a skip, the hinged sections of the guides are swung out of their regular position, the skip is hoisted to the change position, and a chain attached to a chain block hooked into an eye at the top of the skip. The chain block is tightened up, picking up the weight of the skip. The skip is then pushed out of the compartment, the hoisting rope slackened, and the hoisting-rope pin disconnected, thereby releasing the skip.

The chain block is attached to a crab, which is supported on an overhead track, and the skip is moved along this track out of the way, and the cage shoved into position, the hoisting cable attached and the chain block eased up, the air cylinder and frame allowing the cage to be moved over the compartment without shock or swing. The chain block hook is then disconnected, the cage is lowered, and the guides are swung and locked in their proper position. The whole operation requires less than five minutes.

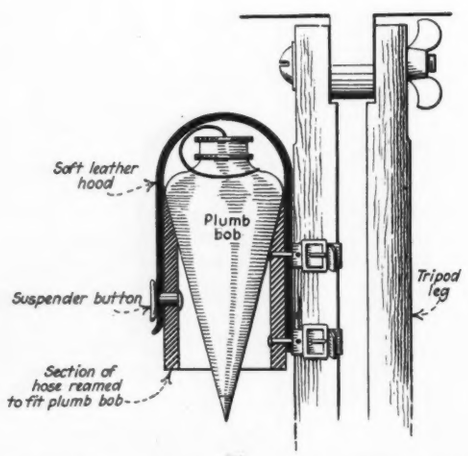
The track supporting the skips and cages extends across in front of the shaft compartments and closes on itself at a point close to the inclined members of the steel headframe. It is at a height to give sufficient clearance in handling the skips. Each skip and cage is provided with separate chain blocks. The device was made in the mine shops.

## The Plumb Bob Pocket

BY S. H. HAMILTON

Written for *Engineering and Mining Journal*

"Do not begin the day's work by leaving the plumb bob behind," says Prof. Tracy. "And do not put it in the transit box," says Experience. "Don't carry it in your pocket," says Friend Wife. So here is a suggestion as to how it may be carried:




POCKET ON TRIPOD LEG FOR PLUMB BOB

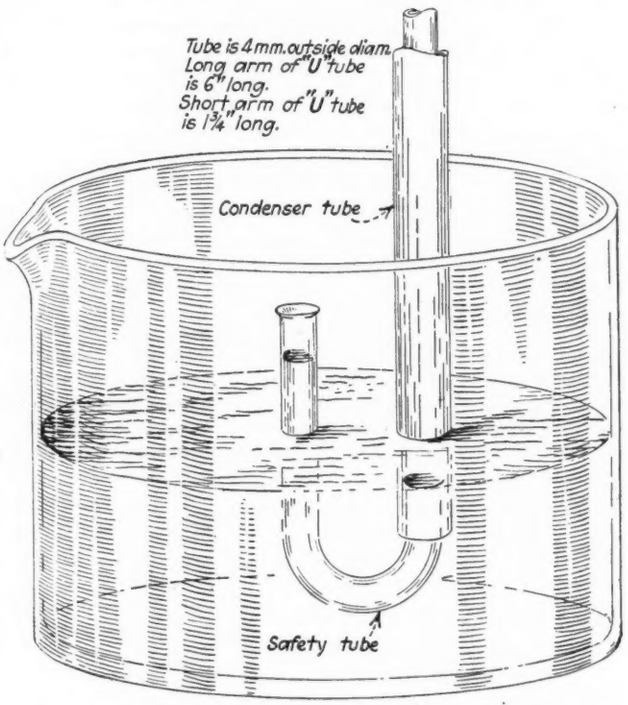
Take a short length of tough but flexible hose (a salesman's sample would be just the thing). Ream out the inside of the hose at one end so that it will receive the plumb bob. A triangular piece of glass from a broken bottle will serve as a taper reamer. A solid ring of uncut hose should be left at the bottom to prevent the bob from slipping through. Fashion a hood or cover for the bob from an old leather upper and attach both to the tripod leg, as shown in the accompanying sketch.

## Safety Attachment to Arsenic Condenser

BY HERMAN SCHWERIN

Written for *Engineering and Mining Journal*

The following notes and sketch describe a device that I have used in my laboratory for several months in connection with an arsenic condenser and which I have found useful in preventing the solution from sucking back into the flask owing to condensation. The device consists of a bent U-tube with one limb about 6 in.




U-TUBE USED IN ARSENIC CONDENSER TO PREVENT SOLUTION FROM BEING SUCKED BACK

long and the other 1¾ in. made of tubing of 4 mm. external diameter. The long limb goes up into the condenser tube. The short limb stands about half an inch above the solution in the beaker. The U-tube is filled with water. If condensation occurs in the flask before the distillation is finished, the water will be sucked back out of the U-tube and then enough air to take care of the condensation will also be sucked through the U-tube. In this way all the distillate is left in the beaker. If the distillation was not complete, the U-tube should be sealed again with a small quantity of water from the wash bottle.

## Cleaning Linen Tracings

BY C. NYE

Written for *Engineering and Mining Journal*

Linen tracings can be thoroughly cleaned with gasoline. A clean wad of cheesecloth or linen is soaked in gasoline, the excess is squeezed out and the surface of the tracing is then carefully wiped with it. It is best to have a clean sheet of paper underneath the tracing when doing this. This method removes all dirt and pencil marks and leaves the ink lines and tracing linen clean and not injured in any way. Better blueprints can be obtained. Of course, the gasoline used should be kept free from dirt. [The gasoline should be free from water also.—EDITOR.]

# THE PETROLEUM INDUSTRY

## Peruvian Oil Fields

BY VERNON F. MARSTERS
Written for *Engineering and Mining Journal*

MORE THAN A CENTURY AGO petroleum in the form of *"la brea"* was known to exist in northern Peru, and formed the basis of a small industry. Its occurrence in the interior from Negritos was known to the Spanish invaders, and it was actually "mined" by them, the product being used for painting ship bottoms. As a national trait of the Spanish people, they were much more interested in the early days in a vigorous search for the precious metals than anything else in Peru. The occurrence of *la brea* interested only the sea-going group, so the little oil deposits, as they oozed from the desert sands near the south end of Cerro de Amotape, were soon forgotten.

In the early 60's activity in the search for petroleum began, and in the early 70's actual drilling was started in the Province of Tumbes. Even at this early date American, English, and French prospectors were scouting the Province of Tumbes and the Department of Piura. English and French prospectors failed in their attempts to find oil in Quwbrada Heath, southwest from Tumbes. An American who had started actual drilling in the region of Zorritos (Province of Tumbes) obtained some appreciable production and later entered into partnership with the well-known business man of Callao, Sr. Faustino Piaggio. This gentleman is now the sole owner of the Zorritos field.

### DEVELOPMENT OF IMPORTANCE BEGUN IN EARLY 90'S

Serious development began in the Negritos field in the early 90's, when Herbert Tweddle transferred his interest in this concession to the London Pacific Petroleum Co. In the Lobitos field prospecting did not begin until 1901, and by 1905, under the direction of the Peruvian Corporation, some fairly good shallow wells had been drilled. In 1905 the Lobitos Oil Co. assumed the ownership of this field. About 1905, the discovery of asphaltic sands, near the northwest slopes of Cerro de Amotape and in the drainage basin of Quebrada de Mancora, Department of Piura, led a Mr. Taiman to drill a well near a point known as La Brieta (Hacienda de Fernandez). Although this well was drilled to a depth of only 455 ft., not less than four distinct sands were found. The production was not large and consisted of a heavy black oil containing an asphaltic base. So far as I am aware no further drilling has been done in this locality.

The remaining producing area of Peru is in the Department of Puno, in the southern part of the Peruvian Republic. The field is on the northwest side of Lake Titicaca. It was first recognized by the Brown brothers, of Los Angeles, Cal., who formed a company to test the region. This area is known as the Pusi or Pirin field. No fewer than ten wells were drilled, and from five to seven of these gave some production. The Pusi field was a producer from 1906 to 1915, when all operations ceased.

The early prospecting in the Peruvian Republic has led to the development of the following fields: The Zorritos field, on the coast line, forty kilometers southwest of Tumbes, Province of Tumbes; the Lobitos field, on the coast line, approximately forty-five kilometers northwest of Talara, Department of Piura; the Negritos field, on the coast, Department of Piura, and extending over large concessions from Talara to the south and east (Talara is the shipping port of the Negritos field); Hacienda de Fernandez (La Brieta), in Quebrada de Mancora and approximately thirty kilometers to the interior from the port of Mancora, Department of Piura, and the Pusi or Pirin field, Department of Puno, on the northwest side of Lake Titicaca and northeast from Juliaca, the railway junction point to Cuzco on the north and Puno on the south.

### FORMATIONS OF THE NORTHERN PERUVIAN OIL FIELDS

From the accompanying map it will be seen that the producing fields in northern Peru are confined to the north end of the coastal plain that borders the Andes on the west and extends to the Pacific shore line. The coastal plain extends north into Ecuador and south through the Province of Tumbes and the Department of Pinra and from Lambayeque to Rio Saña, where the foothills of the Andes reach the coast.

The formations of the coastal plain are composed entirely of Tertiary sediments. My investigations[1] led to the conclusion that not less than 400 ft. of Tertiary sediments would be found in the north arm of the plain or that portion west of Cerro de Amotape. The central and widest part of the coastal plain will probably contain even a thicker series of Tertiary sediments than is exhibited in the north.

In the north sector there are not less than three members in the Tertiary sediment with unconformities existing between each. The uppermost member, composed mainly of coarse sediments with some clays, forms the table-land topography in the region of Payta and the many benches or *mesas* in the interior from Negritos and Lobitos. This member rests unconformably upon a series of red and gray clays, which, from Payta north, form the shore cliffs to the Ecuadorian border.

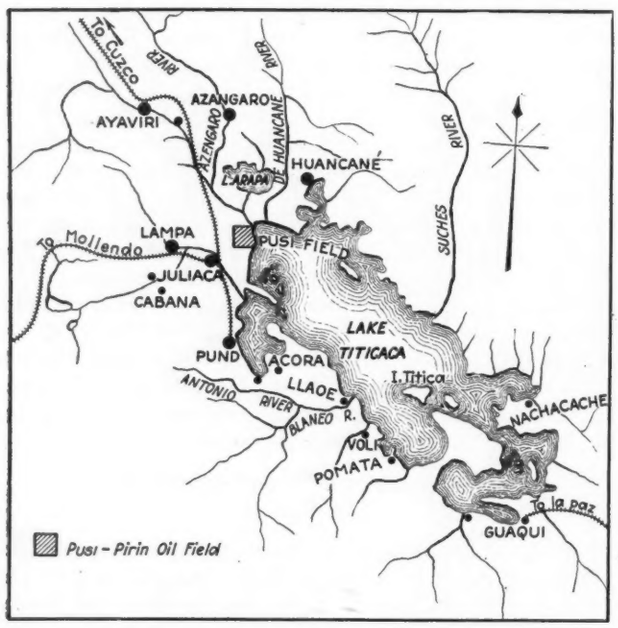
Investigation of well records from different fields has brought to light facts which strongly suggest that another unconformity exists at a depth of approximately 650 ft., and further that this break may occur anywhere from 650 to 1,000 ft. Since these investigations were published a well has been drilled to a depth

[1] "Informe preliminar Sobre la Zona Petrolifera del Norte del Peru," Por V. F. Marsters, Bol. No. 50, Cuerpo de Ingenieres de Minas del Peru.

of 3,900 ft. The drill was still in Tertiary at this depth, so it is evident that the early estimate of the total thickness of the Tertiary sediment in the northern part of the coastal plain had not been overestimated.

It may be stated here that other parts of the Peruvian shore line are likewise bordered by coastal plain sectors, but none of these has been subject to detailed investigation or testing for petroleum deposits, although seepages of oil are known to exist on some of them.

The remaining sectors may be described as follows: The Tambo de Mora-Pisco-Nasca coastal plain, with approximately 250 kilometers of shore line; the Ocoña-Mollendo-Tambo sector, the southeast end of which is




PRODUCING OIL FIELDS OF NORTHERN PERU

not completely severed from the broader and remaining sector, and the Moquequa-Tacna sector, which continues into northern Chile. The Peruvian portion of the plain is bounded on the southeast by the River Sama.

### CHARACTERISTICS OF INDIVIDUAL FIELDS

*Zorritos Field*—The Zorritos field was the first to produce petroleum in commercial amount. A refinery was built in the field during the earlier stages of development. Later the owner, Sr. Piaggio, built a larger refinery at Callao, where he continued to refine his own production and built up a large remunerative trade on the west coast of South America. His refined product was mainly kerosene. According to statistics available, 313 wells had been drilled in this field by 1914. Apparently fifty wells seem to have been the maximum number producing at any one time. Three sands are known in this field. They vary in depth from 194 to 1,640 ft. The deepest well of which I have any note was drilled to 3,020 ft.

*Lobitos Field*—This field is operated by the Lobitos Oil Co. By 1917 that company had drilled 143 producing wells. Not fewer than four sands had been encountered, with depths varying from 400 to 2,500 ft. The deepest well drilled in the field is reported to have reached 3,435 ft. In 1912, drilling operations were greatly increased. During that year a number of flowing wells were obtained, some of which showed an initial production of 500 bbl. per day. This company has its own tank ships, and carries the greater part of its crude to refineries on the coast of British Columbia.

*Negritos Field*—Negritos field was formerly operated by the London Pacific Petroleum Co. It is now under the control of the International Petroleum Co., with the subsidiaries (Standard) Lagunitos Oil Co., London Pacific Petroleum Co., and West Coast Oil Fuel Co. In 1917, a total of 695 producing wells had been drilled in this field. Not fewer than seven distinct producing sands have been found, varying in depth from 300 to 3,000 ft. The deepest well drilled in this field attained a depth of 3,900 ft. Refineries have been established at Talara, the shipping port of this field. The West Coast Oil & Fuel Co. transports all crude and refined products from this section.

*Pusi Field*—In the Pusi field, no detailed investigations have been made by the government officials, as in the northern fields, and such information as may be available is derived solely from those who have conducted private investigations. It can be said with a fair degree of certainty that the formations in the vicinity of the Pusi field are in part Tertiary and in part Cretaceous in age. Favorable structural conditions exist in the Pusi region. The formations with which the Pusi oil deposits are associated are believed to cover a considerable area. In fact, oil seepages are known at many points in the north and northwest extension of the high plains from Lake Titicaca. It is a significant fact that similar seepages are known on the high plains of Bolivia south and southeast of Lake Titicaca, the same geographical and geological province as that on which the Pusi field is situated. The remoteness of this region from the coast and the high cost of transportation are among the difficult factors to be overcome if production in any great amount is ever to be obtained.

In the Pusi field not fewer than ten wells were drilled. Producing sands were found between 250 and 700 ft., the deepest well reaching 1,500 ft. It is understood that much of the production obtained was used as fuel on the engines of the Southern Peruvian Ry.

It may be added, without going into details, that many places remote from the present fields are known to possess seepages showing petroleum of different grades. Samples have been collected from some of these occurrences and tested, with fair results. These localities extend from the coast at points remote from production to the east slopes of the eastern Andean range.

COMMERCIAL CHARACTER OF PERUVIAN PETROLEUM (a)

| Production of the Northern Fields | Per cent |
|---|---|
| Naphtha and gasoline | 15 to 25 |
| Kerosene | 20 to 24 |
| From remaining distillate, lubricating oils constitute | 20 to 30 |
| **Production of the Pusi Field** | |
| Gasoline | 0 to 7 |
| Kerosene | 7 to 20 |

(a) For details concerning Peruvian petroleum see "Los Petroleos Peruanos," por Ricardo A Deustua, Lima, Peru. "Congreso Nacional de la Industria Mineria 1918."

Lubricant oils are present in large amount, but no figures are available.

An accompanying table shows the production of Peru from the earliest date at which any statistics are available to 1920. From the figures, it is evident that the Negritos and Lobitos fields are gradually increasing their production. The Zorritos field reached its maximum production in 1910: from 1910 to 1915 the total annual production fell, but from 1915 to 1918 it was again increased. The only district that has been com-

mercially productive and that is now inactive is the Pusi field, and that fact is due largely to its geographical position and high cost of transportation.

PRODUCTION OF PETROLEUM IN PERU, SOUTH AMERICA, FROM 1896 TO 1920, BY DISTRICTS

| Year | Lobitos, Bbl. | Negritos, Bbl. | Zorritos, Bbl. | Pusi, Dept. of Puno (*a*) Bbl. | Lagunitos, Bbl. | Total Production, Bbl. |
|---|---|---|---|---|---|---|
| 1896 | ..... | ..... | ..... | ..... | ..... | 47,536 |
| 1897 | ..... | ..... | ..... | ..... | ..... | 70,831 |
| 1898 | ..... | ..... | ..... | ..... | ..... | 70,905 |
| 1899 | ..... | ..... | ..... | ..... | ..... | 89,166 |
| 1900 | ..... | ..... | ..... | ..... | ..... | 274,800 |
| 1901 | ..... | ..... | ..... | ..... | ..... | 274,800 |
| 1902 | ..... | ..... | ..... | ..... | ..... | 286,725 |
| 1903 | ..... | ..... | ..... | ..... | ..... | 278,092 |
| 1904 | ..... | ..... | ..... | ..... | ..... | 290,123 |
| 1905 | 75,000 | 335,160 | 37,720 | ..... | ..... | 447,880 |
| 1906 | 162,000 | 330,510 | 42,419 | 1,365 | ..... | 536,294 |
| 1907 | 279,000 | 396,750 | 65,476 | 15,000 | ..... | 756,226 |
| 1908 | 319,896 | 543,750 | 71,429 | 76,103 | ..... | 1,011,180 |
| 1909 | 421,195 | 740,070 | 70,750 | 76,103 | ..... | 1,316,118 |
| 1910 | 400,088 | 773,025 | 107,000 | 50,000 | ..... | 1,330,105 |
| 1911 | 391,290 | 882,698 | 94,048 | 30,000 | ..... | 1,398,036 |
| 1912 | 587,048 | 1,071,000 | 87,095 | 15,000 | ..... | 1,751,143 |
| 1913 | 557,355 | 1,130,490 | 83,343 | 10,000 | 346,673 | 2,133,261 |
| 1914 | 504,743 | 1,032,210 | 88,136 | 10,000 | 282,713 | 1,917,802 |
| 1915 | 664,972 | 1,355,925 | 72,736 | 1,000 | 392,618 | 2,487,251 |
| 1916 | 654,060 | 1,822,733 | 73,852 | ..... | (*b*) | 2,550,645 |
| 1917 | 686,595 | 1,771,560 | 75,262 | ..... | (*b*) | 2,533,417 |
| 1918 | 639,698 | 1,820,814 | 76,190 | ..... | ( ) | 2,536,102 |
| 1919 | ..... | ..... | ..... | ..... | ..... | 2,616,000 (*c*) |
| 1920 | ..... | ..... | ..... | ..... | ..... | 2,790,000 (*d*) |

(*a*) Quoted from Richardson, U. S. Geological Survey. (*b*) Quoted from American Petroleum Institute. (*c*) Estimated. (*d*) Included in the Negritos production.

PETROLEUM PRODUCTION OF SOUTH AMERICAN REPUBLICS FOR 1920

| Countries | Barrels |
|---|---|
| Peru | 2,790,000 |
| Argentine | 1,366,926 |
| Trinidad | 1,628,637 |
| Venezuela | 300,000 |

In the world's production of petroleum, Peru ranks the ninth, Trinidad the eleventh, Argentine the thirteenth, and Venezuela the fourteenth in the list of oil-producing countries.

## Petroleum in Panama

The following summary regarding petroleum resources in Panama has been prepared for the U. S. Geological Survey, section of Foreign Mineral Reserves, by Arthur H. Redfield:

Evidences of petroleum in Panama occur on both the Pacific and the Caribbean coasts of the narrow isthmus, whose backbone of ancient crystalline and post-Tertiary igneous rocks is flanked on both sides by sediments chiefly of Cretaceous and Tertiary age. Seepages of oil or asphalt are reported on the shores of San Miguel Bay; along the Tonosi River; around the Gulf of Montejo; and along the Mosquito Gulf, especially near Bocas del Toro.

Little is known or published regarding the geology of Panama outside the Canal Zone. The indications of oil in Panama appear to occur in Tertiary formations. The sedimentary rocks of Panama resting unconformably on the igneous backbone of the isthmus are folded into steeply dipping, shattered, and faulted anticlines and synclines, bearing N. 55-60 deg. W., intruded in places by igneous rocks. A recognized anticline is found in the State of Bocas del Toro, extending through Columbus Island, Provision Island, Nancy's Cay, and Valiente Peninsula. The most promising portion of the anticline is a dome-like structure occurring on Columbus Island.

The petroliferous character of the Panaman formations is attested by seeps of oil and asphalt. Gas was encountered in a well drilled for water near Bocas del Toro.

Active development of the Panama oil fields is of recent date. A well drilled by the Sinclair Gulf Corporation in 1918 on the center of Columbus Island is producing considerable gas.

Early in 1917 the National Assembly of Panama authorized the making of concessions of unoccupied territory for purposes of exploration for not more than three years, and for purposes of development for not over twenty years. These are renewable for like periods. The royalty prescribed is 10 per cent of the net profits of the oil or gas marketed, or 5 per cent of the gross receipts.

The Sinclair Gulf Corporation (U. S.) holds a concession for exploration covering 11,000,000 acres in the Republic of Panama, with the right to select and retain 1,200,000 acres. This is a strip of land fifteen miles wide, extending for considerable distances along both coasts of the republic. The Chorcha Petroleum Co. has permission to prospect claims located about twelve miles from David, State of Chiriqui. The Chorcha company's holdings have been leased by Thomas Navins & Co., of New York.

## Nova Scotia Oil Shales To Be Treated

SPECIAL CORRESPONDENCE

The rich torbanitic oil shales of New Glasgow, Nova Scotia, will soon be worked by a low temperature carbonization process. During the last six months experiments have been carried out at the works of the Carbonization Co. in Pennsylvania in co-operation with the Pennsylvania Coal & Coke Co. The shale was shipped in carload lots from the Nova Scotia fields and was worked during the final runs under the supervision of Harold C. E. Spence, owner of the properties, and Dr. B. F. Howard, chief of the Fuel-Testing Division, Mines Branch, Geological Survey, Ottawa, and others. The type of retort has a capacity of from 50 to 100 tons per day and can be brought up to 300 or more tons per day for single retorts. Harold C. E. Spence has purchased the Canadian and Newfoundland rights, and on interviewing the Minister of Customs, Ottawa, received assurances the retorts would be allowed in Canada free of duty.

The property consists of about twenty thousand acres and contains several billions of tons of shale. The deposits have been bored to 1,200 ft., showing numbers of seams aggregating 600 to 700 ft. in thickness. The torbanites are found to be richer than any others discovered, carrying from 80 to 135 gal. of oil per ton, and some picked samples showing as high as 199 gal. per ton. The product can be pumped into ocean-going tankers on the field a mile from the works, and the upper seams to a height of 150 ft. above the river levels can be mined by open-cast workings and quarrying. A plant of 5,000 tons' capacity per day is planned for the initial operations. A torbanite yields better oil than an oil shale, at a lower temperature, and the oil refines more easily. The yield of oil also is invariably higher. With access to the Atlantic and the Gulf of St. Lawrence direct from the works, transportation is ideal.

[In our issue of May 14, p. 851, it was incorrectly stated that Harold C. E. Spence is president of the Nova Scotia Oil Fields, Inc. Mr. Spence is president of the Oil & Nitrate Products, Ltd.—EDITOR.]

# Technical Papers

**Mine Atmospheric Conditions.**—The South African Institution of Engineers publishes in its *Journal* for March, 1921 (Johannesburg, price 4s.), an account of quantitative studies by A. J. Orenstein and H. J. Ireland, carried out at the request of the South African Chamber of Mines, to determine the influence on the output and fatigue of workers, of atmospheric conditions and noon rest, and the best working period for efficiency. By means of ergometers devised and calibrated by themselves, they measured work performed in different ways by two African native miners at different levels in the Village Deep mine and at the surface, during June to December, 1920. Atmospheric conditions were observed by means of the kata-thermometer, and varied by means of a blower or fan. Surface tests were made at 6,000 ft. altitude, and underground between depths of 4,500 ft. (1,500 ft. alt.) and 5,260 ft. (740 ft. alt.). The authors reach conclusions essentially the same as those urged by D. Harrington, of the U. S. Bureau of Mines, in his paper read before the Lake Superior conference. Noteworthy points made are: A short rest at half-time seemed to be not worth while; air-stirring may increase work output by 46 per cent; four hours underground, at full capacity, is all that a South African native can put in efficiently at the place where the experiments were conducted.

**Storing Coal**—Those who have had trouble with their coal stockpiles catching fire will be interested in a well-illustrated article in the April 15 issue of *Factory* (price 25c., Cass, Huron and Erie Sts., Chicago, Ill.). Cold weather, small piles, and ventilation tend to prevent spontaneous combustion by keeping the temperature down; or a deep pile may be made, surrounded by a tight board fence, and covered by a layer of fines, thus preventing the access of air necessary for combustion.

**Scrapers**—"The Use of Scrapers in Metal Mines," by Lucien Eaton, appears in the May issue of the *Compressed Air Magazine* (11 Broadway, New York, N. Y., price 35c.). This article reviews the machinery and methods used in several districts in "slushing" work. It is well illustrated with photographs and diagrams. Much interest is attached to the practice of "slushing," and in the Lake Superior districts the methods have greatly reduced the cost of ore removal.

**Chromium Ore**—"Chromium Ore" is a separate monograph in the series being issued by the Imperial Institute, London, S. W. 7, England, and may be obtained for 3s. 6d. This is a brochure of fifty-eight pages, describing the occurrences, character, and uses of chromium ore and giving brief references to sources of world supply.

**Picric Acid**—Large stocks of picric acid were in the hands of the Government at the close of the war, and must be used up in industrial work. Ordinarily this explosive is too expensive and causes too much smoke to be used commercially. The U. S. Bureau of Mines *Reports of Investigations* No. 2,243, fifteen pages, free from the Bureau, Washington, D. C., tells of the history and nature of picric acid and how it should be used.

**Iron Ore**—Under the title "Mesabi Sinter," Clement K. Quinn & Co., Duluth, Minn., and Cleveland, Ohio, has issued an illustrated brochure describing the plant, process, and product of the Mesabi Iron Co., Babbitt, Minn. The sinter is obtained by the treatment of magnetic concentrates in Dwight & Lloyd machines after fine grinding and concentration. Flow sheets of the various processes are given.

**Mine Fires**—The use of emergency fans for fighting mine fires is described in U. S. Bureau of Mines *Reports of Investigations* No. 2,240, three pages, obtainable on request to the Bureau at Washington, D C.

**Oil Production**—The U. S. Bureau of Mines has issued Bull. 194, "Some Principles Governing the Production of Oil Wells," by Carl H. Beal, former petroleum technologist of the Bureau, and J. O. Lewis, former chief petroleum technologist. The bulletin discusses some of the fundamental factors affecting oil production. The subjects covered include porosities of oil sands, ultimate production of recoverable oil, the percentage of oil recovered from oil sands with present-day methods, the effect of geologic structure and rock pressure and depth on ultimate production, well spacing, water conditions, factors governing the decline of oil wells, the policy of drilling to maintain production, and considerations on "flush" and "settled" production.

**Salt**—"Permian Salt Deposits of the South-Central United States" is the title of U. S. Geological Survey Bulletin No. 715-M, obtainable on request to the Survey at Washington, D. C. The bulletin is of eighteen pages and gives the principal data so far obtained concerning the vast salt deposit which has been discovered by drilling for oil, gas, and water in New Mexico, Texas, and Oklahoma.

**Cadmium**—"Cadmium in 1920," six pages, containing statistics and other summarized information about the metal and its marketing, may now be obtained from the U. S. Geological Survey, Washington, D. C.

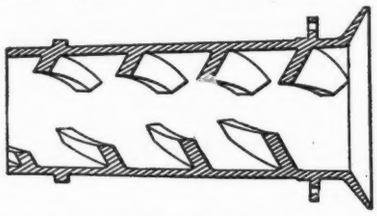
**Safety Fuse**—*The Detonator* for March, 1921 (1540 San Pablo Ave., Oakland, Cal., sent free), has a two-page article discussing the various kinds of fuse, their uses, and methods of storage.

**Asbestos**—"Asbestos in 1919," a nine-page separate of "Mineral Resources," is now obtainable from the U. S. Geological Survey, Washington, D. C.

# Recent Patents

**Blast Furnace Charging**— No. 1,376,947. Jules Labarthe, San Francisco, Cal. A method which consists in dumping charges at different parts of a furnace, the quantity of each constituent in the complete charge being the same in any vertical line.

**Ball-mill Discharge**—No. 1,369,653. N. L. Hall, Salt Lake City, Utah. The prevention of oversize material from discharging through the trunnions of mills not provided with grates, by means of interrupted spiral vanes on the inner surface of the trunnion discharge spout. These vanes are cast



successively higher toward the outlet end, to secure proper classification. The illustration shows a discharge spout so made.

**Sulphur Dioxide**—No. 1,377,013. William H. Howard, Salt Lake City, Utah, assignor to American Smelting & Refining Co., New York, N. Y. A method of obtaining a continuous flow of $SO_2$ in converting copper matte by treating different batches each for a predetermined time. Another process for recovering sulphur dioxide from matte is covered by patent No. 1,377,012 issued to the same applicant.

**Flotation Process** — No. 1,375,233. Walter A. Scott, Chicago, Ill., assignor to Minerals Separation North American Corporation, New York. A process by which the gas used for floating mineral particles is removed from the bubbles before they reach the surface of the pulp, and the mineral carried by the bubbles separated from the remainder of the ore.

**Flotation Machine** — No. 1,374,447. William E. Greenawalt, Denver, Col. A flotation machine in which the compressed air, supplied at the bottom, is atomized by means of rotating perforated disks revolving between perforated stationary plates.

**Flotation Machine** — No. 1,374,499. William E. Greenawalt, Denver, Col. A flotation machine with a rotary member and means for passing an electric current from the rotary member to the stationary members.

**Flotation Reagent**—British patent No. 1.077.20. Luckenbach Processes, Inc. Pine pitch converted to a colloidal state by treatment with caustic soda or ammonia and other alkalies and certain oxidizing and fixing agents is claimed to give improved and selective effects in the flotation of minerals.

# ECHOES FROM THE FRATERNITY

## SOCIETIES, ADDRESSES, AND REPORTS

### Standardization Conference Held in London Will Promote Mutual Understanding

The secretary of the American Engineering Standards Committee, Dr. P. G. Agnew of Washington, D. C., has just returned from a short trip to Europe, in the course of which he attended the conference in London of the secretaries of national standardizing bodies of several countries. After the London conference he visited France, Switzerland, and Germany for a more detailed study of the standardization work in those countries.

The conference, which was called by the secretary of the British Engineering Standards Association, C. le Maistre, had for its object the exchange of experiences and the furtherance of co-operation among the various national bodies in their work of industrial and engineering standardization.

It is interesting to note that, notwithstanding great differences in the details of procedure, the same general method of work is followed in the countries represented. Technical decisions concerning any specific piece of work are in the hands of a working committee which is so constituted as to be broadly representative from both the technical and the managerial points of view of the particular branch of the national industry concerned. This same general method is followed, whether the work is of the nature of specifications, methods of test, or dimensional standardization.

The secretaries who attended will submit the suggestions of the conference to their respective home organizations for approval.

The suggested measures have to do with the interchange of publications, a reciprocal arrangement for making foreign standards available to the industries of each country through their sale by the offices of the national bodies, the exchange of information as to the status of work in progress, and other methods of furthering co-operation among the national bodies.

It was the view of the conference that international co-operation in industrial standardization work should proceed along such informal lines, being based primarily upon the interchange of information on active subjects of mutual interest, rather than by any attempt at the present time to form a general international standardizing body. In cases in which formal organization should be found necessary, it was held that the organization should preferably be by subject or industry, somewhat along the lines of the International Electrotechnical Commission; but that in all cases efforts should first be made to secure results by less formal methods. To this end it would often be desirable that, in a given subject, the office of one of the national bodies most interested should by informal agreement perform such secretarial functions as would further international agreement in the particular subject.

Arrangements are being made for close co-operation among the national standardizing bodies and the International Chamber of Commerce. The chamber will give special consideration to the subject of standardization at its convention in London the week of June 27, and has organized a committee to develop interest in the subject on the part of industrial and commercial interests, and to distribute information on standardization. It is the policy of the International Chamber of Commerce to further the standardization movement by such means, considering only the more general aspects of the problem and the policies to be followed. The details of industrial standardization it would leave to the national bodies, who will co-operate directly with the national organizations of the International Chamber of Commerce in their respective countries.

It was felt by all concerned that the conference was a very successful one, and that it constituted an important forward step in establishing a closer relationship and understanding among the various national bodies.

The secretaries present were: Belgium, G. Gerard; Canada, R. J. Durley; Great Britain, C. le Maistre, C. B. E.; Holland, E. Hijmans; Norway, A. Eriksen; Switzerland, M. Zollinger; United States, P. G. Agnew.

### The Story of Sulphur Interests Southern California Engineers

#### Local Section of A. I. M. E. Holds Annual Meeting and Dinner in Los Angeles

The annual meeting of the Southern California Section of the American Institute of Mining and Metallurgical Engineers was held at the City Club, Los Angeles, on the evening of May 12, with Dr. Ralph Arnold presiding and fifty-seven members present. The principal feature of the program was a paper presented by Colonel Seely W. Mudd, whose subject was "The Story of Sulphur." The address was illustrated by two reels of moving picture obtained through the courtesy of the U. S. Bureau of Mines. After giving a general résumé of the sulphur industry, Colonel Mudd presented in detail the different steps involved in the mining of sulphur by the use of superheated water under pressure, as practiced in the Texas gulf district. This interesting account was followed by the election of officers for the ensuing year. The account showed that Harvey S. Mudd had been elected chairman; Alvin B. Carpenter, vice-chairman; Desaix B. Myers, secretary-treasurer; and F. B. Close, Walter A. Schmidt, Harry R. Johnson, and W. F. Staunton, as members of the executive committee.

Following the business meeting a buffet supper was served. The office of Secretary D. B. Myers is 433 Merchants National Bank Building, Los Angeles, Cal.

### Forty-fourth Annual Dinner of the Royal School of Mines

#### Old Students From Many Countries Express Appreciation of the School and Its Influence

The Old Students' Association of the Royal (British) School of Mines conducted the annual dinner of the school on May 27 last. As reported in a recent issue of *The Mining Journal* (London), Professor S. J. Truscott, president of the association, was in the chair, and representatives from all corners of the empire were in attendance.

Sir Edgar Walton, High Commissioner for South Africa, proposed the toast to the school, and in the course of his appreciatory remarks took occasion to urge that if the school granted degrees the latter should be a guarantee that the holders were not only engineers and miners, but also possessors of a wider knowledge enabling them to deal with questions of economics, of health, and of bodily safety.

The president thanked Sir Edgar for his assurance that South Africa recognized the importance of her mining industry, and took occasion to point out, among other things, that though the British Isles had limited mineral wealth, nevertheless her engineers had first developed the cyanide process, and had also developed the flotation process, thereby adding to the stores of precious metals available to humanity.

Sir James Allen, High Commissioner for New Zealand, and Mr. C. McDermid, secretary of the Institution of Mining and Metallurgy, made replies to the toast, "Our Guests." Sir James pointed out that the graduates of the school were spreading through parts of the world other than the dominions and that through them the Royal School of Mines was exerting considerable influence on public opinion throughout the world. Mr. McDermid, after recounting the many difficulties that had often hindered the development of the school and of the Imperial College, stated that it could be demonstrated that the latter had now reached vigorous manhood and that, judged by any standard, it occupied a unique position in the world.

## MEN YOU SHOULD KNOW ABOUT

**George H. Gerry** is making examinations in the Lordsburg and Central districts of New Mexico.

**J. R. Finlay**, mining engineer of New York City, has been retained to appraise the mines of New Mexico.

**E. H. Nutter**, of San Francisco, Cal., chief engineer of Minerals Separation, Ltd., is in New York City for two or three weeks.

**F. G. Stevens**, mining engineer of Toronto, Ont., has gone to the Rex mine, in northern Manitoba. He will spend the summer there.

**C. E. Van Orstrand** has completed temperature measurements in the well of the Hope Natural Gas Co., at Volcano, W. Va.

**Charles W. Wright**, mining engineer, of Rome, Italy, who had been in Michigan recently for a couple of weeks, sailed from New York on June 17, returning to Italy.

**William F. Ward**, mining engineer with the Carrib Syndicate, has returned from Colombia, S. A., and will spend the next few months in New York City and in Denver, Col.

**D. H. Harrington**, supervising mining engineer of the U. S. Bureau of Mines, with headquarters at Denver, has been in Washington conferring with the chief mining engineer of the bureau.

**R. G. Hall**, manager of Burma Corporation, Ltd., operating the Burma mines, railway, and smelting plant at Namtu, Burma, has resigned and will return to the United States at an early date.

**Stanly A. Easton** general manager of Bunker Hill & Sullivan Mining & Concentrating Co., Kellogg, Idaho, has been appointed a member of the Idaho State Board of Education and of the Board of Regents of the University of Idaho.

**Dr. George A. Young**, of the Canadian Geological Survey, left Ottawa on June 8 for his trip to the Belcher Islands in Hudson Bay. He and his party will spend the summer making an examination of the iron-ore deposits of the islands.

**Irvine E. Stewart, consulting petroleum geologist, of Stewart & Wright, Lewistown, Mont., announces the dissolution of that firm. Mr. Stewart has opened offices in Billings, Mont., where** are associated with him **Fred A. Davies**, geologist, and **Edwin H. Hunt, engineer.**

**Max Ball**, petroleum geologist, of Denver, Col., who recently resigned as manager of the Matador Oil Co. of Wyoming, was in Washington last week. He is now in New York City conferring with **Charles Lupton** and ex-Governor Frantz, of Oklahoma, on affairs connected with the Ute Oil Co.

**C. A. Fisher**, of the firm of Fisher & Lowrie, consulting geologists and engineers, Denver, Col., is a delegate from the American Petroleum Institute to the first annual meeting of the International Chamber of Commerce to be held in London on June 27 to July 2. Mr. Fisher sailed on June 14.

**Dr. H. M. Ami**, of Ottawa, has returned there from London, where for the last three months he has been acting governor of the Imperial Mineral Resources Bureau. In January Dr. Ami went to the south of France to recuperate after a prolonged service at the Washington, D. C., headquarters of the bureau. He expects to resume work with the Canadian Geological Survey.

**Scott Cardelle Bone**, of New York City, whose nomination as Governor of Alaska was confirmed by the Senate on June 15, has made a special study of the affairs of that territory since 1911,

*Harris & Ewing*

SCOTT C. BONE

when he became editor-in-chief of the *Seattle Post-Intelligencer*. In 1914 and 1915 he was chairman of the Alaska bureau of the Seattle, Wash., Chamber of Commerce. Mr. Bone was born in Shelby County, Ind., on Feb. 15, 1860. He was for some years prominently connected with Indianapolis papers until in 1888 he went with the Washington, D. C., *Post*, the managing editor of which he finally became. After seventeen years on the *Post's* staff he was for a short period editor of the *Herald*, of that city, but left in 1911 to go to Seattle. Mr. Bone's long active service on one of the best papers of the National Capital, gave him an unusually broad grasp of national affairs and interests. Among other honors he has received a foreign decoration.

**Colonel H. H. Stout**, who recently returned from New York City to Douglas, Ariz., where he has been superintendent of the Copper Queen smelter for the last four years, announces that he has temporarily severed his connection with the smelter. After traveling through the West and Northwest Colonel Stout, who is a graduate of West Point Military Academy, will return to New York City as consulting metallurgist for Phelps Dodge interests.

**James Hopkins**, mining engineer, of Ramey, Pa., who returned from the diamond fields of the Belgian Congo in April, has been engaged for exploration work on the west coast of Africa. He sailed from New York on June 15 by the "Mauretania."

**Mining engineers recently in New York City** included: **Arthur Notman**, of Bisbee, Ariz.; **Gunnar Schjelderup**, of Christiania, Sweden; **William Kelly**, of Vulcan, Mich.; **Djevad Eyoub**, of the National Petroleum Corporation, Constantinople, Turkey, and Tampico, Mexico; **Frederick G. Lasier**, of Detroit, Mich.; **Charles T. Joslin**, of the Arizona Mining Supply Co., Prescott, Ariz.; **W. F. Staunton**, of Los Angeles, Cal.; **Horace V. Winchell**, of Minneapolis, Minn.; **Veleair C. Smith**, of Tuzpam, Vera Cruz; and **William Ryer Wright**, of Evanston, Ill.

## OBITUARY

**Captain James E. Richards**, superintendent of the Isle Royale mine, Isle Royale, Mich., died there toward the end of May after a long illness. Captain Richards spent the first twenty years of his life at the Cliff mine, Keweenaw County, Mich., where he was born on June 11, 1858. He early learned the practical side of mining from his associates. About 1880 he moved to Osceola, and after several years there went to the Tamarack Junior mine as master mechanic. Nine years later, still in the same capacity, he went over to the Isle Royale, where he spent the rest of his life, eventually attaining the superintendency.

**James F. Callahan**, part owner of the Callahan Zinc-Lead Mining Co., formerly the Consolidated Interstate-Callahan company, died at his home at Wallace, Idaho, June 12, after a stroke of paralysis. Mr. Callahan went to Eagle, Idaho, in 1883, when he was twenty-five years old and before the town of Murray was established. He discovered the Interstate-Callahan deposits in 1885, but worked on them until 1887 before he located the property. Despite a small showing in his tunnel and wall-rock theretofore not known to be associated with pay deposits, his faith held and was finally rewarded by his uncovering some of the richest pockets in the Cœur d'Alenes. Mr. Callahan was born in Galena, Ill., Aug. 12, 1858, and started westward in 1876, when he set out for the Black Hills of Montana. On the way he worked in Minnesota lumber camps and elsewhere. In 1879 he had reached Montana and found work among the cattle ranchers until the news of the gold discoveries in Idaho in 1883 drew him into the Cœur d'Alenes at Murray.

# THE MINING NEWS

## LEADING EVENTS

WEEKLY RÉSUMÉ

*The action of the House Committee on Mines and Mining in refusing to concur in the Senate bill permitting further postponement of the 1920 assessment work on mining claims makes it appear unlikely that any such legislation will pass. A statement of Secretary Fall's regarding Mexican petroleum reserves is alleged to have been twisted to aid a bear movement in the stock market. The Senate Committee on Public Lands has reported a bill amending the act admitting Washington, Montana, and the Dakotas as states in order to permit mineral lands there to be leased on a different basis.*

*In California, the Shasta Zinc & Copper Co. has recently started its new plant at Winthrop. In Arizona, United Verde Extension passed its quarterly dividend. The property of the Silver King of Arizona, at Superior, is to be sold by the sheriff on July 6. In Texas, the hearing of the suit of the Union Sulphur Co. against the Texas Gulf Sulphur Co. has been postponed until October. Considerable activity is reported from Mexico, in the district tributary to Culiacan, Sinaloa. In Colorado, the long-delayed spring thaw has caused floods that have isolated Ouray, Telluride, and Silverton. In Nevada, strike conditions at Tonopah are practically the same. In the Black Hills, the Homestake Mining Co. has just announced a 50c. cut in wages. In the Coeur d'Alenes, the report that the Bunker Hill and Hecla companies were to work the Star mine jointly has been confirmed by the managers of both companies.*

### Shasta Zinc and Copper Co.'s Plant Started

**Reverberatory Handling 160 Tons of Ore Per Day**

The Shasta Zinc & Copper Co., at Winthrop, Cal., started its reverberatory recently, and is smelting at the rate of 160 tons of ore per day. From twenty to thirty days will be required before all parts of the plant are in proper working adjustment. Clean slag, low in zinc and copper, was being made at the start. Successful operation of the plant seems to be assured. Over two and one-half million dollars in new capital has been put into the enterprise. A description of the plant will be published in an early issue.

### Homestake Cuts Wages

The Homestake Mining Co., of Lead, S. D., has announced that it will make a general reduction of wages of 50c. per day, effective July 16. This will make miner's wages $4.50 and shoveler's $4 per day.

## The New Copper Queen Concentrator, at Bisbee

**Phelps Dodge Corporation Is Now Completing Four-Unit Mill of 4,000-Ton Initial Capacity —Expected To Be in Operation in Five Months**

By J. Boyd Trimble, Jr.*
Written for *Engineering and Mining Journal*

THE NEW MILL of the Copper Queen branch of the Phelps Dodge Corporation, which is situated near Bisbee, Ariz., is nearing completion. It was designed and is being built by H. Kenyon Burch, consulting engineer for the Phelps Dodge concentrating department. The initial capacity of the four units in the concentrator will be 4,000 tons treated per twenty-four hours. The capacity of the crushing plant is greater than otherwise would have been the case, as it is designed to handle leaching and smelting as well as milling ore. The mill will handle ore from Sacramento Hill, a large open-pit deposit of low-grade porphyry previously described in *Engineering and Mining Journal*.

#### The Coarse-Crushing Plant

Ore will be brought from Sacramento Hill in 40-yd. side-dump cars and discharged over a stationary grizzly into the receiving hopper of a 66 x 84-in. Blake jaw crusher set to 8 in. It will then be conveyed by two 4-in. pan conveyors to a 500-ton surge bin. Four 48-in. apron feeders will feed the 8-in. product to two 48-in. belt conveyors, which will carry it over two revolving grizzlies to the gyratories. These are two No. 9 Gates crushers set to 4 in.

Provision has been made under the surge bin for bypassing leaching and smelting ore through a series of four 42-in. belt conveyors, having an aggregate length of 918 ft., to the concrete loading bins. It will also be possible, if found desirable, to run the smelting ore through the gyratories, or gyratories and disks.

The 4-in. milling ore from the gyratories will be carried by two 36-in. belt conveyors to four Allis-Chalmers iron-frame trommels having 2-in. round openings. The oversize will pass to four 48-in. Symons disk crushers which will complete the coarse crushing to 1¼ in.

Trommels constitute the screening equipment at present installed. A different type of screen is now being considered. A final decision has not been reached.

A 42-in. inclined belt conveyor, 335 ft. long, will discharge on to a 42-in. belt conveyor over the 10,000-ton crushed-ore bins. The latter conveyor, in turn, will discharge on to a shuttle conveyor which will distribute it.

It is desired to complete the crushing of the entire 4,000 tons of milling ore in one eight-hour shift. The leaching and smelting ores will occupy another shift. However, if the tonnage of the latter two warrants it, the plant will operate the full twenty-four hours.

#### Concentrator Will Have Four 1,000-Ton Units

Wet grinding will start in the primary mills. Six 20-in. apron feeders will regulate the flow of crushed ore through a series of three 24-in. belt conveyors to two 6½ x 12-ft. Marcy roller mills. These mills, each driven by a 150-hp. motor, will carry a normal charge of eighteen tons of 3-in. diameter high-carbon steel rods at a speed of 17.5 r.p.m. The primary reduction will be 14 mesh.

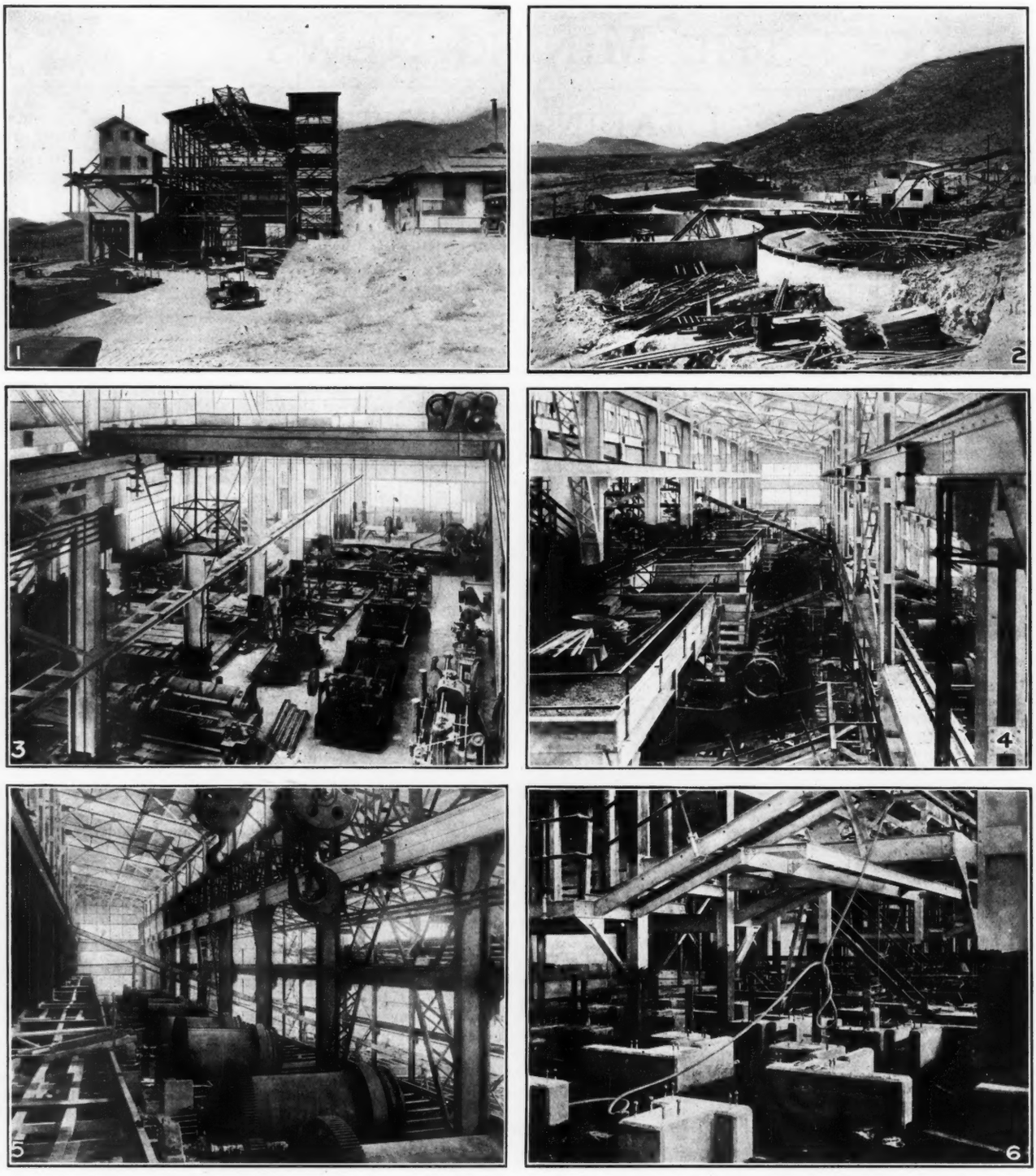
The 14-mesh product will pass for desliming to one 6 x 18-ft. Dorr classifier. The slimes will be floated as described later. The sands will flow to ten Plato tables for roughing. An air lift will elevate the coarse concentrates to Blaisdell excavator bins, from which they will be dropped to standard railroad cars.

Two secondary mills, identical with the primary mills, each in closed circuit with a Dorr duplex classifier, will further reduce to 48 mesh and classify the sands from two 4½ x 18-ft. Dorr classifiers which will dewater the reject from the roughing tables. The resulting pulp will be combined with the slimes from the primary classifiers and treated in two Callow machines of the Inspiration type. The rougher concentrates will be elevated by air lift to two Callow cleaners. The cleaner tailings are to be returned to roughers.

The rougher machines each have twenty-two cells, with a total area of 231 sq.ft., and can handle a total feed of 2.11 tons per sq.ft. per twenty-four hours; and 1.92 tons of this will be returned from the cleaners. The cleaner machines each consist or six cells, with an area of 83 sq.ft., and can handle a feed of 1.62 per sq.ft. per twenty-four hours.

Flotation machine boxes will be made up of concrete slabs 6 to 10 ft. wide, 2½ in. thick and from 10 to 20 ft. long. The slabs, reinforced by ½-in. rods, will be cast flat and bolted in place when

*Formerly engineer with Phelps Dodge Corporation, Concentrating Department.



VIEWS OF PHELPS DODGE CORPORATION'S NEW COPPER QUEEN CONCENTRATOR, BISBEE, ARIZ.

1. Filter Plant and Blaisdell Tanks, Feb. 1, 1921. 2. Dorr Tanks, 75 ft. in Diameter, March 1, 1921. 3. Machine Shop Interior, April 1, 1921. 4. Primary Mill Floor and Classifiers, April 1, 1921. 5. Secondary Mills from Roughing Table Floor, Feb. 16, 1921. 6. Roughing Table Foundations, March 15, 1921. Forty Roughing Tables Are Called for in the Flow Sheet.

being erected. Grooves 3 in. wide in the floor provide ½-in. caulking.

A new series of experiments is in progress to determine the best design for the air bottom. Several types are under consideration, but nothing definite is yet forthcoming.

Twenty Plato finishing tables will receive and treat the flotation tailings, each table handling 38.5 tons. These tables, as well as the roughing tables, will be driven by individual 1-hp. motors. All tables are provided with concrete discharge boxes. The walls of these are 2½ in. thick, reinforced by ¼-in. rods. Each tailing and each concentrate box is cast entire in a special wood-and-steel plate form and moved into place after setting.

Flotation and finishing-table concentrates will be combined with the return from the Blaisdell tanks and thickened in six 75-ft. diameter Dorr tray tanks. The capacity of these is 1.02 tons per sq.ft. per hour for a total effective area of 42,450 sq.ft.

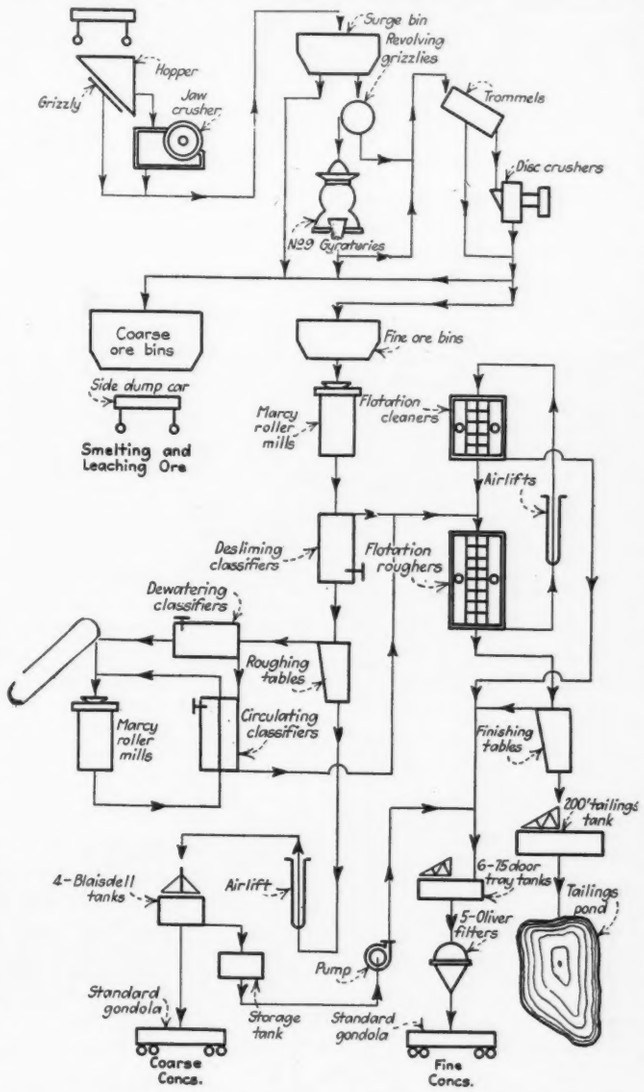
The dewatered concentrates will be lifted by two bucket elevators to five 14 x 14-ft. Oliver filters, from which, after filtering, they will drop into the fine-concentrate bins.

Dewatering of the final tailings is to be accomplished in a 200-ft. diameter Dorr tank. All Dorr tanks and the Blaisdell tanks, as well as several storage tanks, are of reinforced concrete.

Scarcity of water has made it imperative to reclaim all water possible. A total of 1,516 gal. is required per ton or ore treated. Of this, 376 gal. will be fresh, the remaining 1,140 gal. being returned from the Dorr tanks and filters.

Fresh water is to be obtained from the Calumet & Cochise shaft, a company property approximately 1,000 yd. on the other side of the mill. It will be pumped from the 1,800 level through a 200-ft. tunnel to a 1,000,000 gal. reservoir above the mill. A maximum use is made of the sloping mill site to provide a gravity flow of pulp. Belt conveyors, where used, have ball-bearing troughing and return idlers. All conveying and crushing machinery is equipped with an automatic electric interlock, preventing damage and delay due to stoppage of any one unit. Power will be obtained from the smelter power house at Douglas. A subsidiary Diesel plant, however, is installed at the mill site and will provide 6,000 hp. The buildings are all of steel, with corrugated iron siding and composition roofing, except the power house, which has concrete side walls, and the warehouse, which has a concrete roof. All foundations are of concrete. Construction throughout is extra heavy, to lessen the cost of replacements. A sample mill has been designed and will eventually be built. For the present, however, there is no need for it.

It is expected that the completed mill will be in operation before five months have elapsed.




FLOW SHEET OF NEW COPPER QUEEN CONCENTRATOR, BISBEE, ARIZ.

## Minnesota Steel Buys Adjacent Acreage

The Minnesota Steel Co., a subsidiary of the U. S. Steel Corporation, has added to its holdings by purchasing 330 acres, which will give it all the water front between its present plant and New Duluth. There is some speculation as to the purpose for which this ground is to be used.

## Bunker Hill and Hecla Combine To Operate Star Mine

### Managers of Both Companies Confirm Report—Hecla Workings and Equipment To Be Used

The most important piece of news affecting mining operations in the Cœur d'Alene district, Idaho, that has been heard in many months is that regarding the combination of the Bunker Hill & Sullivan and the Hecla mining companies in taking over and operating the Star mine, reference to which was made in a recent issue of the *Engineering and Mining Journal*. The report has now been confirmed in a public statement authorized by Stanly A. Easton, manager of the Bunker Hill & Sullivan, and James F. McCarthy, manager of the Hecla. According to this statement, the two companies will co-operate in the development of Star ground which has been under option to the Bunker Hill & Sullivan company. The option price is not given in the statement, but from a dependable source it is learned that it is $750,000. The option has now been transferred to the Sullivan Mining Co., which will be the operating corporation, and the stock will be divided equally, 50 per cent each, between the Bunker Hill and Hecla companies. The plan of development is explained in the following paragraph taken from the statement:

"It is planned to use the Hecla workings and the Hecla equipment for development and mining the Star ground. A crosscut will be run from the 2,000-ft. bottom level of the Hecla to reach the Star vein, which it is estimated will have an approximate length of 8,000 ft. Preparation for this work has already begun. A special skip pocket at the 2,000-ft. station and a bin at the collar of the shaft will have to be constructed before development work begins, to handle the waste from the Star development and the output of ore. Work on these is now under way."

An interesting feature of the statement is the reference to the electrolytic zinc plant to be established by the Bunker Hill. Of this project the statement says: "The Bunker Hill company for upward of two years has been experimenting in the electrolytic reduction of zinc ores with special reference to the treatment of the zinc product from the Star mine. Substantial progress has been made in this experimentation and a small pilot test plant is now in operation upon zinc concentrates from the Star, and plans are being developed for a plant of sufficient capacity to treat local custom zinc ores from Pine Creek, Sunset and elsewhere as well as the entire Star output."

## Silver King Coalition Arranges New Contract with A. S. & R. Co.

The Silver King Coalition Mines Co., of Park City, Utah, has settled its controversy with the American Smelting & Refining Co., so that it pays $2 more per ton than its contract requires, the contract being extended to Jan. 1, 1926, and the extra $2 being stated by the smelting company to be the amount it has been losing on the Coalition ores. According to the new arrangement the mining company will be given a market for low-grade sulphide ores, which up to the present time it has not been able to ship.

## Independent Steel Companies Cut Wages

A reduction in wages and salaries of employees, effective June 16, has been announced by independent steel companies of the Pittsburgh and Youngstown districts. Although in all instances the amount of the cut was note definitely announced, it is assumed it will be 15 per cent, as the Brier Hill Steel Co. has announced that it has made such a cut.

Another announcement effecting the mill men has been made by the Jones & Laughlin Steel Co., of Pittsburgh, to the effect that all overtime will be abolished. This order follows the course set by other companies of recent date.

## Miners' Wages in United States Show General Decrease

Wages paid metal miners in fifty non-ferrous metal-mining camps in the United States by sixty-one companies are given in the accompanying table. Wages paid on Jan. 1, 1919, Jan. 1, 1920, and at present are compared.

A COMPARISON OF NON-FERROUS METAL MINERS' WAGES IN THE UNITED STATES

| State | Camp | No. of Companies Reporting | Class | Wages Jan. 1, 1919 | Wages Jan. 1, 1920 | Wages June 1, 1921 |
|---|---|---|---|---|---|---|
| Arizona | Warren District | 2 | Machine men | $6.10 | $6.10 | $4.50 |
| | | | Common labor | 3.25—3.75 | 3.25—3.75 | 2.20—2.40 |
| | Globe | 3 | Machine men | 5.15—5.90 | 5.15—6.15 | 4.40—4.50 |
| | | | Common labor | 3.90—5.90 | 3.15—5.65 | 2.50—4.00 |
| | Miami | 1 | Machine men | 5.90 | 6.15 | 4.50 |
| | | | Common labor | 4.15 | 3.90 | 2.50 |
| | Johnson | 1 | Machine men | 5.00 | 5.00 | 5.00 |
| | | | Common labor | 4.00 | 3.50 | 5.00—5.50 |
| | Huron | 1 | Machine men | .... | 6.15 | 5.15 |
| | | | Common labor | .... | 5.50 | 4.50 |
| | Oatman | 2 | Machine men | 5.50—6.00 | 6.00 | 5.00 |
| | | | Common labor | 5.00—5.50 | 5.50 | 4.50 |
| | Dos Cabezas | 1 | Machine men | 4.00 | 4.50 | 4.50 |
| | | | Common labor | 3.00 | 3.50 | 3.00 |
| | Jerome | 2 | Machine men | 5.90—6.10 | 5.10—6.10 | 4.50 |
| | | | Common labor | 3.50—4.00 | 3.00—3.70 | 2.50—3.00 |
| New Mexico | Mogollon | 1 | Machine men | 4.50 | 4.50 | 4.25 |
| | | | Common labor | 3.50 | 3.50 | 3.25 |
| Texas | Shafter | 1 | Machine men | 2.75 | 3.00 | 3.00 |
| | | | Common labor | 2.00 | 2.25 | 2.25 |
| California | Portola | 1 | Common labor | 4.50—4.75 | 4.50 | 4.25 |
| | Shawmut | 1 | Machine men | 4.00 | 4.50 | 4.00 |
| | | | Common labor | 3.50 | 4.00 | 3.25 |
| | Engelmine | 1 | Machine men | 4.50 | 4.50 | 4.50 |
| | | | Common labor | 3.50 | 3.50 | 3.50 |
| | Grass Valley | 1 | Machine men | 4.00 | 4.40 | 5.00 |
| | | | Common labor | 3.00 | 3.25 | 3.75—4.00 |
| | Copperopolis | 1 | Machine men | 4.50 | 4.50 | 4.50 |
| | | | Common labor | 4.00 | 4.00 | 4.00 |
| | Keswick | 1 | Machine men | 5.00 | 5.25 | 5.25 |
| | | | Common labor | 3.75 | 4.00 | 4.25 |
| | Plymouth | 1 | Machine men | 4.00 | 4.50 | 4.00 |
| | | | Common labor | 3.50 | 4.00 | 3.50 |
| | Sheepranch | 1 | Machine men | 4.00 | 4.25 | 4.25 |
| | | | Common labor | 3.50 | 3.75 | 3.75 |
| South Dakota | Lead | 2 | Machine men | 4.00—4.25 | 4.00—4.25 | 5.00 |
| | | | Common labor | 3.60—4.00 | 3.60—4.00 | 4.25—4.50 |
| Colorado | Hahn's Peak | 1 | Machine men | 5.00 | 5.50 | 5.00 |
| | | | Common labor | 4.00 | 4.50 | 4.50—4.25 |
| | Victor | 1 | Machine men | 4.50 | 4.50 | 4.50 |
| | | | Common labor | 3.75 | 3.75 | 3.75 |
| | Naturita | 1 | Machine men | 6.00 | 6.00 | 5.25 |
| | | | Common labor | 4.50 | 4.00 | 4.00 |
| | Cripple Creek | 1 | Machine men | 4.50 | 5.00 | 4.50 |
| | | | Common labor | 3.75 | 4.25 | 3.75 |
| | Aspen | 1 | Machine men | 3.50 (*a*) | 4.00 (*a*) | 4.00 (*a*) |
| | | | Common labor | 3.50 (*a*) | 4.00 (*a*) | 4.00 (*a*) |
| | Boulder | 1 | Machine men | 5.50 | 5.50 | 4.50 |
| | | | Common labor | 5.00 | 5.00 | 4.00 |
| | Telluride | 1 | Machine men | 5.00 | 5.00 | 4.50 |
| | | | Common labor | 4.25 | 4.25 | 3.75 |
| | Breckenridge | 1 | Machine men | 5.25 | 5.25 | 4.75 (*a*) |
| | | | Common labor | 4.75 | 4.75 | 4.25 |
| Utah | Eureka | 1 | Machine men | 4.75 | 5.25 | 4.25 |
| | | | Common labor | 4.25 | 4.75 | 3.75 |
| | Park City | 1 | Machine men | 5.25 | 5.25 | 4.25 |
| | | | Common labor | 4.75 | 4.75 | 3.75 |
| | Alta | 1 | Machine men | 5.00 | 5.25 | 4.25 |
| | | | Common labor | 4.50—4.75 | 4.75—5.00 | 3.75—4.00 |
| | Bingham Canyon | 1 | Machine men | 5.00 | 5.25 | 4.25 |
| | | | Common labor | 4.25 | 4.50 | 3.75 |
| Nevada | Battle Mountain | 1 | Craftsmen | 5.25 | 4.75 | 4.75 |
| | | | Common labor | 4.75 | 4.25 | 4.25 |
| | Tonopah | 1 | Machine men | 5.50 | 6.00 | Strike |
| | | | Common labor | 5.00 | 5.50 | Over 75c. cut |
| Idaho | Wallace | 3 | Machine men | 5.25 | 5.25 | 4.25 |
| | | | Common labor | 4.75 | 4.75 | 3.50—3.75 |
| | Kellogg | 1 | Machine men | 5.25 | 4.75 | 4.25 |
| | | | Common labor | 4.75 | 4.50 | 4.00 |
| | Quartzburg | 1 | Machine men | 5.50 | 5.50 | 5.50 |
| | | | Muckers | 4.75 | 4.75 | 4.75 |
| | Salmon | 1 | Machine men | 5.00 | 6.00 | 4.00 |
| | | | Common labor | 4.00 | 4.50 | 3.50 |
| | Porthill | 1 | Machine men | 62½c. | 62½. | 56¼c. |
| | | | Common labor | .50 | .50 | .44½ |
| Montana | Kendall | 1 | Machine men | 4.50 | 4.50 | 4.50 |
| | | | Common labor | 4.50 | 4.50 | 4.50 |
| | Butte | 3 | Machine men | 5.75 | 5.75 | 4.75 |
| | | | Common labor | 4.75—5.00 | 4.75—5.00 | 4.25 |
| Oregon | Homestead | 1 | Machine men | 5.25 | 5.75 | Shut |
| | | | Common labor | 4.75 | 5.25 | down |
| Washington | Valley | 1 | Machine men | 5.50 | 4.50 | Shut |
| | | | Common labor | 5.00 | 4.00 | down |
| | Chewelah | 1 | Machine men | 5.00 | 5.50 | Shut |
| | | | Common labor | 4.50 | 5.00 | down |
| | Northport | 1 | Machine men | 4.50 | 5.00 | 4.25 |
| | | | Common labor | 4.00 | 5.00 | 3.50 |
| Tennessee | Ducktown | 2 | Machine men | 40—44c. | 49c. | 38—41c. |
| | | | Common labor | 28—33c. | 39c. | 30—31c. |
| Arkansas | Bauxite | 1 | Machine men | 50c. | 50c. | 35c. |
| | | | Common labor | 35c. | 35c. | 20c. |
| Illinois | Rosiclaire | 1 | Machine men | 5.00 | 7.00 | Shut |
| | | | Common labor | 2.50 | 3.00 | down |
| | Galena | 1 | Machine men | 4.00 | 4.25—4.75 Jul 1 | 4.00 |
| | | | Shovelers | 3.50 | 3.75—4.25 Jul 1 | 3.50 |
| Wisconsin | Platteville | 1 | Machine men | 4.00 | 4.50 | 3.50 |
| | | | Shovelers | 3.50 | 4.50 | 3.00 |
| Michigan | Painesdale | 1 | Machine men | 4.75 | 4.80 | 3.15 |
| | | | Common labor | 4.50 | 4.60 | 2.70 |

(*a*) With board. One company reports a 25c. increase since January, 1920

## Hearing Postponed in Suit of Union Sulphur vs. Texas Gulf

A preliminary hearing of the suit of the Union Sulphur Co. vs. Texas Gulf Sulphur Co. was held before the district court at Galveston, Tex., on June 6. The hearing was postponed until October at the plaintiff's request.

## Peñoles Mining Co. Expands

### Now Entirely Self-Contained—Supplies Its Smelters and Refineries With All Fuel, Ore, and Transportation

The Peñoles Mining Co. (Cia. Minera de Peñoles, S. A.), owning mines and smelters at Mapimí, Durango, is one of the most important and best-known lead and silver producers in Mexico. It has recently acquired all of the mines, smelters, and refineries belonging to the Cia. de Minerales y Metales as well as its share interest in kindred properties, thus consolidating into one organization all the interests heretofore separately held by the Cia. de Minerales y Metales and the Peñoles Mining Co., both of which are managed and controlled by the American Metal Co., Ltd. These properties also include important coal mines, fully equipped for production of the coal and coke required in the smelting operations of the Peñoles company. Included in this transaction is the transportation equipment of the Cia. de Minerales y Metales, consisting of thirty large locomotives, 700 railroad cars, and extensive repair shops in Monterrey. Thus the Peñoles company has become an entirely self-contained enterprise, furnishing to its own smelters and refineries all their fuel and ore requirements and the transportation thereof.

## Mayo Silver Ore To Be Smelted At Selby

About 3,000 tons of silver-lead ore mined in the Mayo district of the Yukon will be sent to Selby, Cal., for smelting. The regulations of the Department of the Interior of the Dominion provide that it must be refined in Canada, but this shipment has been permitted by an Order in Council, in view of the fact that there are at present no Canadian smelters who can accept the ore.

## Vogelstein Petition Dismissed

The U. S. Court of Claims has dismissed the petition of L. Vogelstein & Co. against the Government for $424,196 in connection with copper purchases during the war.

## Oliver Iron Mining Co. Curtails

Operations of the Oliver Iron Mining Co., the mining subsidiary of the U. S. Steel Corporation, on the Gogebic Range in Michigan, were reduced by half June 20. In all, 2,500 men are now working day shift only on that range. Shipments from stock have also been cut in half. Similar action has been taken on other ranges.

On the Mesabi, the Oliver company will reduce its open pit and underground forces 25 to 30 per cent at once in the Hibbing and Chisholm districts.

Officials in Washington who are keeping close to the Russian situation are of the opinion that no great amount of gold still is held in Russia. Purchases being made in that country have decreased more and more.

# NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

## Time for 1920 Assessment Work Not To Be Extended

**House Committee Refuses To Concur in Resolution Passed by Senate**

No further suspension of assessment work requirements on mining claims will be authorized. Rights to claims will lapse on July 1 if the statutory $100 worth of labor has not been performed. The Senate passed a bill suspending assessment work up to and including June 30, 1921. The Committee on Mines and Mining of the House, however, refused absolutely to concur in the proposition, and, after extended discussion of the subject, voted against the bill. Only one vote was cast for a favorable report on the bill. This action of the House Committee is expected to put an end to the constant agitation for the continued suspension of assessment work.

Though the Senate passed the exemption bill without a rollcall being demanded, it was evident that there was no great amount of enthusiasm for the measure. Senator Smooth, of Utah, said it ought to be thoroughly understood that no further exemption should be allowed, even if the present bill should become a law. "If we are going to develop mines in the West," he said, "we cannot develop them by continually exempting the assessment."

The bill, as it passed the Senate, contained a proviso that, to secure the advantage of the act, notice would have to be filed before Aug. 1. It was argued that this time was insufficient, for the reason that information as to that action would not reach many holders of mining claims in time. It would give an unfair advantage to the claim holders who have access to newspapers and journals, Senator Smoot argued.

Senator Walsh, of Montana, insisted on the passage of the bill and on the retention of Aug. 1 as the date of notice, so that knowledge could be had as to the claims which have been abandoned during the last three and one-half years.

The hard work done in the Senate to secure the passage of the bill came to naught, however, as the action of the House committee eliminates all chance of securing the legislation.

## Fall Withholds Recommendations On War Minerals Relief

The Secretary of the Interior expects to make no rulings as to war minerals relief policies until he has received the recommendations of Ira E. Robinson, the new commissioner.

The status of war minerals relief affairs, as of June 11, is as follows: Unexpended balance of the appropriation, $4,672,021.91; total amount recommended for award on 380 claims, $3,441,860.06; number of claims recommended for disallowance, 824; amount involved in disallowed claims, $9,507,805.99; total administrative expense, $386,118.03, or 2.07 per cent of the total amount of the claims considered.

## Would Lease Mineral Lands Differently in Four States

**Senate Committee Reports Bill Amending Act Admitting Montana, Washington, and North and South Dakota to Union**

A new basis for leasing mineral lands in Montana, Washington, and North and South Dakota is provided in a bill which has been reported out of the Senate Committee on Public Lands with the recommendation that it be passed. The measure amends the act which admitted these states to the Union and authorizes the leasing of mineral lands for a longer period than that fixed in the original act. The original statute provides that public lands granted to these states may be sold at not less than $10 per acre, or leased for periods of not more than five years. The committee recommends that the law be changed so as to bring these lands under the General Leasing Act.

Senator Walsh, of Montana, points out that it is quite appropriate to provide for the sale of agricultural land at not less than $10 per acre and that leases should not be for periods greater than five years. He calls attention to the fact, however, that ordinarily lands believed to be valuable on account of the mineral contained in them are not salable at any price, or by reason of their highly speculative character can be sold for cash in an amount very much less than development may show to be their actual value. Such lands, he says, usually are acquired in these states under what is known as a lease and bond, by which the prospector goes into possession without an initial payment upon an agreement to carry on certain development work and to pay a royalty on any mineral he may extract, with the right to purchase within a period named in the instrument.

The Public Lands Committee is of the opinion that mineral lands should not be sold, but should be leased for a twenty-year period as is prescribed in the General Leasing Law.

## Government's Silver Purchases

Purchases of silver under the Pittman Act during the week ended June 18 totaled 918,000 fine ounces. This brings the total purchases under this act to 59,331,697 fine ounces.

## Fall's Statement on Petroleum in Mexico Twisted

**Effort To Depress Value of Oil Stocks Seen—Secretary Said Reserves Were Large**

Bearish interests on the Stock Exchange have used a recent letter of the Secretary of the Interior in a clever way in their effort to depress the value of Mexican oil stocks. Entirely erroneous deductions have been made from the letter, even by some of the more careful news services. The full text of Secretary Fall's letter, which was written to the Secretary of State on May 27, is as follows:

"It is generally reported that some of the important fields that swelled Mexico's output in 1920 are being rapidly drained of their oil, although reports differ widely regarding the extent of the depletion. Mexico contains oil reserves that have been conservatively estimated by this department at 4,500,000,000 bbl., but the present issue relates to Mexico's ability to maintain her production from this reserve at the rate established in 1920 in response to market demand. Public concern naturally springs from the lack of unquestionable information regarding the results from drilling done and in progress and the development of new fields of the type that yield the present production.

"The information at hand in this department is not of the authenticated nature requisite to the formulation of a report to Congress and to the public on a question so critical as that of the prospective output of oil in Mexico."

It is clear that Secretary Fall's point is that there are large reserves of petroleum in Mexico and that it is only a matter of the relative speed of production and consumption.

There are many indications that those most interested are taking no stock in the pessimistic reports and rumors as to Mexican oil production. It is pointed out that the Dutch interests are expending large sums of money for additional tank steamers. Practically all of the large producers in Mexico are spending enormous sums on pipe lines. One of the companies is building a $175,000 hospital, an improvement which would not be made unless there were expectation that its activities would expand.

The present controversy centers around the report of a business man who made an investigation for the Shipping Board. This is pointed to as another example of probable consequences when a business man is sent to make a report on a technical subject. "It is like sending a geologist to examine a bank," says the head of one of the important technical bureaus in Washington.

### Need for Separate Department Of Mines Pointed Out By Shortridge

Senator Shortridge in supporting his contention that there should be a separate Federal department established (as proposed in his bill reported last week) in recognition of the basic importance of the mining industry, said in part as follows:

"A grave danger exists in that there is now no adequate system of obtaining and recording data relative to the mineral industries such as was shown to be of first importance to the successful prosecution of the war. Such data would even in peace time be of inestimable service to the Government and the public in co-ordinating and bringing about a wise balance of development of resources as a basis for trade.

"No adequate system now exists for investigation or inspection of the manufacture and handling of explosives, and the misuse of these materials is a constant source of danger and loss to the public. While responsibility must in the main rest upon the states for regulation, the power to investigate and report, together with the power to regulate transport in interstate commerce, may be properly used to remove a large portion of this danger. . . .

"Power development is at the heart of all industry, and only by introducing more power will it be possible to sustain and enlarge American industries of all kinds without opening the doors to the unlimited influx of labor from all the world. Power comes from water and fuel, and any large schemes for cheaper power development can only be realized with a thorough knowledge of the distribution and character of the water and fuels available. For this reason it is proposed to centralize in the Department of Mines and Mineral Resources the activities of the Federal Government as regards power.

"Ten years ago, in response to an insistent public demand for a Department of Mines, a bureau of mining, metallurgy, and mineral technology was created in the Department of the Interior by Congress. In a report favoring establishment of such a bureau made by the House Committee on Mines and Mining (59th Congress 1st Session, Report 1184) this statement was made:

" 'What the Congress may ultimately do toward further recognition of this industry must necessarily be largely a matter of growth as the situation develops. Several of the executive departments have started as bureaus and have been enlarged from time to time as their work and its importance grew. The committee hopes that such may be the case with the legislation under contemplation.' . . .

"The United States is the largest producer of minerals in the world and one of the few powers which has no department of mines. With the largest industry our Government has done relatively the least to help the miner and has been repeatedly forced in the face of grave national emergency in time of war or domestic strife to resort to temporary organization in order to collect and compile the necessary facts, to say nothing of determining a policy. An informed, alert, fact-finding organization in intimate touch with all branches of the mineral industry is of first importance and will be a national asset."

# NEWS BY MINING DISTRICTS

## London Letter

### Latest Report of Zinc Corporation Unfavorable—Another Gold Discovery Alleged in Nigerian Tin District

BY W. A. DOMAN

**London, June 7**—In consequence of the labor troubles at Broken Hill and elsewhere, the report of the Zinc Corporation for the last calendar year makes a very unfavorable showing. This is not surprising when one remembers that operations were suspended for a period of nineteen months. Work was only possible for about the last three or four weeks in December, and on resumption the expenses of unwatering the mine reached the high figure of 3s. 2d. per ton of ore treated. The total cost of mining and milling was 48s. 4d., a substantial and serious advance upon the 27s. 6d. ruling in the previous year.

Doubtless to assist costs, the grade of the ore mined was high, namely, 10.4 per cent zinc, 2.8 oz. silver, 17 per cent lead, as compared with 9.1 per cent zinc, 2.8 oz. silver and 15.5 per cent lead during the previous period. The recoveries of silver and lead in the lead concentrates were 76.1 per cent and 87.8 per cent respectively, rather better than before, owing to the higher grade of the ore. The zinc recovery was not quite so good—57.1 per cent against 59 per cent—owing to the zinc in the slime residue not being removed during the latter portion of the period.

Little in the nature of development work could of course be done, so that the ore reserves show scarcely any variation. At Dec. 31 last there were 2,115,700 tons, averaging 14.6 per cent lead, 2.6 oz. silver and 9.4 per cent zinc, as compared with 2,114,600 tons with the same metallic contents a year earlier. These figures do not include the zinc lode. The quantity of tailings left on the dumps is 664,633 tons. Even now operations at the mine are restricted, showing that the wage award made last September involves conditions that at the present price of lead cannot profitably be fulfilled. The result is that productive work is restricted to the zinc-treatment department. The preference shares, which before the war were considered one of the finest of mining investments, do not receive any dividend for the second half of last year, the matter remaining in abeyance until conditions at Broken Hill improve.

I have previously referred to the discovery of gold in Nigeria. It sometimes happens that when one company has a find, the manager of another is stimulated to search and also makes a discovery. Within the last few days, the Dua Tin Co. reports having found a deposit giving high values in gold, say 1 oz. to the cubic yard. The news naturally excites curiosity, and the market is awaiting further news. Another company, the Akoko Main Reef, reports having struck a rich new shoot at a depth of 350 ft. yielding by assay "phenomenal results." The figures have evidently been cabled over here, but are not published; confirmation, however, has been requested. There may be a good deal in the gold discoveries at present being reported in West Africa, but some skeptics attribute the matter rather to a desire to invigorate the share market.

## MEXICO

### Sinaloa

### Santa Cruz de Ayala Properties Change Hands

**San Lorenzo District**—J. T. Wallace and associates, of New York and Bisbee, Ariz., have recently acquired large copper holdings in the San Lorenzo district near the station of Quila, on the Southern Pacific Ry. of Mexico. Development work will start at once on these properties with the intention of blocking out a large tonnage of copper-silver ore. This company will probably connect its holdings with the main line of the Southern Pacific at Quila with a railroad of its own to facilitate transportation of supplies.

At Santa Cruz de Ayala the properties of the old West Coast Mining Co. have been taken over by Frank Noble, John R. Rogers, and Enrique Peña. They have large holdings in the Santa Cruz section, and are now installing machinery and a complete cyanide plant to treat the old tailings from the concentrator. These properties were worked extensively over 100 years ago and have a large record of production. The property is equipped with a ten-stamp mill and Wilfley tables. The concentrates shipped assay about 650 oz. silver and 3 oz. gold per ton, leaving about 16 oz. in silver in the tailings. This will be cyanided in the future, and experiments show that a saving of 80 per cent of the value can be made from these tailings.

**Cosala District**—At Cajon de Minas the Prieta mine being operated by E. A. Montgomery and associates is again ready to operate the thirty-ton flotation mill. The ore is complex, and on account of the zinc contents some difficulty has been encountered in getting good extraction. The mill has recently been reconstructed, and it is expected that a good extraction will be made when operations are resumed.

**Mocorito District** — The Los Cuates (meaning "twins") mine is under option to J. Q. Kiler and associates from California. This property is near the famous Santiago de los Caballeros properties which are now being worked by the same parties. The Cuates was a famous silver producer before the revolution and has been worked for fifty years by the Piero family living at Pericos, in the State of Sinaloa. The ore was of such a grade that they experienced heavy losses during the revolution, shipments of native silver being made which averaged 95 per cent in silver, with no gold. The property has a ten-stamp mill, with pan amalgamation to treat the low-grade ores. This will be put in order at once by the new purchasers, and operations will begin on a large scale.

Senator Zerapio Lopez, Gaston Schwob and Ernesto Espinosa are installing a five-stamp mill on their property near the Potrero mines. This is a gold property and said to contain high values.

Denouncements continue to pour into the mining agencies, and it is expected that with the recognition of the Obregon government there will be an unprecedented boom in the mining circles of this section of Mexico.

### Durango

#### San Juan de Mata Mine Sold to Filer and Innes

**Copalquin District**—The San Juan de Mata mine, at the town of Chihuahuilla, in extreme western Durango, has been sold by the Rocha Company, of Mexico City, to Filer and Innes, of San Francisco. This property has been a famous producer of silver and gold for many years. Several million dollars of high-grade shipping ore have been sent to Selby in San Francisco by the previous owners. There is said to be a large tonnage of milling ore in sight, carrying 40-50 oz. silver. The new owners intend to dismantle the old five-stamp mill which is now on the property, and install a modern mill with flotation and cyanide. This property with modern methods installed gives promise of making one of the big silver producers of western Mexico. The consideration in this sale is not known.

**Topia District**—On the Sianori Creek, near the township of Sianori, W. G. Pike and associates are developing a gold property recently acquired. This is said to contain good values in silver as well as gold and it is the intention of the purchasers to install a mill as soon as development will warrant.

### Zacatecas

#### Relocation of Old Properties Continues

**Sombrerete**—The mining agency at this place has recorded a number of filings during the past month. American mining men who have taken up new properties in the camps included in this district are John Emerson, Charles E. Snider, Gerald Norton and George Davis. A number of old mines recently forfeited for non-payment of taxes have been relocated and several new groups of prospects have been filed on.

## CANADA

### Ontario

#### Value of Nipissing's Output for Five Months Decreases $1,000,000

**Porcupine**—At the Dome mines the stamp equipment which has not latterly been in operation has been overhauled, bringing the capacity of the mill up to about 1,400 tons daily.

The North Crown has suspended mining operations pending financial readjustment. The exploration campaign carried out with a view of finding new orebodies did not meet with the success anticipated.

**Kirkland Lake**—The first clean-up has been made at the Wright-Hargreaves after the mill had been in operation for about a month. Details have not been given out. The mill is heating approximately 140 tons per day.

The new orebody recently discovered at the 900 level of the Kirkland Lake is being opened up. The vein is stated to contain an average gold content of about $20 per ton across a width of 7 ft.

The shaft of the Bidgood is being dewatered preparatory to resuming work.

**Cobalt**—During May the Nipissing mined ore of an estimated net value of $142,036, and shipped bullion from Nipissing and customs ore of an estimated net value of $61,207. For the five months ended May the money value of production shows a decrease of nearly one million dollars as compared with the corresponding period of 1920, the figures being $724,434 for the current year as against $1,731,464 for the first five months of last year.

### British Columbia

**Troy**—The Consolidated Silver-Lead Mining Co., a consolidation of the Silver Tip, J. P. Lead, and Troy mining companies, is arranging to extend its No. 3 tunnel, which has been driven 475 ft. and has to go 350 ft. further to cut the vein. There are twenty-six claims in all, located on Grouse Mountain, Lincoln County, about twelve miles from Troy. The values are in silver, lead, and zinc.

**Sandon** — About thirty-five men are employed on outside work in preparation for the extension of milling facilities of the Silversmith mine. Two cars of crude ore have been shipped recently to Bunker Hill smelter, at Kellogg, Idaho, as a test.

**Salmo**—The Nugget is maintaining an output averaging 80 tons per day, with a crew of thirty-five men. It is possible to increase the mine output to 100 tons, if skilled miners can be obtained. No shortage of other labor is reported. Ore is also being taken from the Motherlode. Improved mill efficiency is reported by the management. The outlook is regarded as good for a satisfactory season.

### Alberta

**Edmonton**—Gold is reported to have been discovered on Cadotte river, about seventy miles notheast of Peace River town.

## WASHINGTON

#### Iron Creek Mining Co. Adding Cyanide Plant to Mill

**Seattle**—The state mining commission began an investigation early in June, in an effort to find the true financial status of the coal companies, so as to arrive at satisfactory recommendations to operators and miners with a view to ending the shutdown of coal mines in this state.

**Keller**—The Iron Creek Mining Co., which practically completed a 20-ton mill last year, is adding a cyaniding section, with a view to securing a better saving than is possible by milling alone. Values are in silver and lead, with a trace of gold. It is anticipated that production will be started in August, this year. About ten men are at present employed on development and mill work.

Preparations by R. H. Blevins, for development of a large acreage controlled by him, is proceeding favorably.

**Springdale**—A contract has been let for hauling ore from the Queen and Seal mine, in the Deer Trail district, to the S. F. & N. station at Springdale. About 125 tons is reported to be ready, with more being taken out.

The Security Copper Co. has started development of the Chamokane and Copper Butte groups, west of here. Some prospecting is being done by the same company on the Security group, near Chewela.

**Kettle Falls**—The main crosscut in the Silver Queen mine, after being driven 1,070 ft., cut the vein at a vertical depth of 400 ft.

**Chewelah**—No indication of activity on the part of magnesite producers in this section is manifest, although the American Refractories Co. has had 500 tons of burned magnesite moved from the Double Eagle mine to Valley, for shipment east. This material was mined and burned before operations came to a standstill last fall.

**Quinalt** — The Big West Copper Syndicate, which has been developing a group of copper-bearing claims in the Olympic Mountains at the headwaters of south fork of the Quinalt River, has been forced to discontinue work for a short time until the snow is entirely gone, in order that more surface prospecting may be carried on. Spokane capital is behind the venture to a large

extent. The original discoveries were made just before the war by trappers, and the ground remained unworked until last year.

**Northport**—Because of cessation of operations at the smelter here many residents have been removing to other places. Definite information as to intentions of Northport Smelting Co. as to resumption of operations are entirely lacking. Rumors, however, are plentiful. The bulk of the ores treated locally have come from the Day partnership properties; namely, the Hercules and the Tamarack & Custer, in the Cœur d'Alenes, and some ore has come from the Day properties at Republic. The increase in freight rates has added another unfavorable factor to the differential that has always prevailed against Cœur d'Alene ores brought here for reduction.

**Republic**—San Poil and Knob Hill mines are among the local properties which will probably produce a good tonnage this season. The former is credited with having 3,000 tons broken and ready for shipment. Re-establishment by the Great Northern of the old freight rate has given a decidedly healthier tone to mining in this section and revival of interest in gold mining also improves the outlook. Because of its being largely of a self-fluxing nature Republic ore is much desired by smelters of the Northwest.

**Spokane** — The Montana Phosphate Co., operating at Maxville and Philipsburg, Mont., has moved its general offices from Maxville to Spokane.

## OREGON

### Gold Mining Industry Reviving Around Baker

**Baker City**—A marked revival in gold mining activity in the territory surrounding Baker City appears imminent. Many properties, long inactive, show signs of re-opening, and inquiry for likely-looking ground is very much improved.

## MONTANA

### Lukens-Hazel To Resume When Lead Reaches 5½c.

**DeBorgia**—Installation of compressor equipment by the Silver Pick Mining Co. on what was formerly known as the Rock Island group is planned. The property has been under development all winter.

**Troy** — Snow Storm Mines Consolidated is maintaining a crew of about twenty men. Development consists of drifting on No. 7 level, with some upraising. There is no prospect of early resumption of production.

**Libby**—A 25 x 65-ft. boarding house, capable of accommodating seventy-five men, is being built at the Lukens-Hazel mine. It will adjoin the mill, which was completed last year. Officially it is announced that as soon as lead reaches 5½c. per lb. mine and mill will be started on capacity production.

**Dunkleberg**—Ore development in the Butte & Western Mining Co's. Forest Rose property is reported progressing satisfactorily and plans for building a concentrator at Jens, Mont., are being considered. The first-class ore is said to average $80 per ton and the second-class from $20 to $25.

**Elkhorn**—Arrival of ball mills for the 700-ton concentrator of the Boston & Montana Development Co. is reported, and the installation of machinery is under way.

**Philipsburg**—Shipments monthly by the Philipsburg Mining Co. are aggregating fifteen carloads of silver ore, carrying an average of 50 oz. per ton and forty carloads of manganese ore.

**Champion**—The Butte & Jardine has started three eight-hour shifts at the Champion mine and the 150-ton mill is reported to be operating at capacity. Returns of over $6,000 have been received from a carload of concentrates. Another car has been shipped. The Atchison farm adjoining the Champion group of claims has been purchased for $5,000. Five of the Champion veins are believed to strike through this property.

**Butte**—Gossip is to the effect that Anaconda is planning to resume operations early at one of its larger copper mines, confining itself to a limited production of high-grade ore, which will be utilized for furnishing metal to the wire works. Although no mine has been mentioned considerable talk has revolved around the West Colusa property.

Appraisers for the Anaconda have been looking over the plant of the du Pont powder works, several miles west of Butte. The du Pont interests have suspended operations and plan to abandon the works. A large part of the machinery has already been shipped to Chile, but the tanks and vats will be left, and it is said that Anaconda has these in mind as being of possible use were the plant to offer any advantages in connection with the corporation's entry into the field of the manufacture of fertilizer.

## IDAHO

### Mill at Armstead Mines To Be of 150 Tons Capacity

**Talache**—Definite announcement has been made by Major H. H. Armstead as to the capacity of the mill to be built this summer at the Armstead mine. The plant will be able to handle 150 tons per day. Development of the mine continues with a crew of about twenty-five men, with work concentrated on the main raise. About 100 men will be employed when mill construction gets under way. A new motor road is being built to connect the scene of operations with Sagle, the shipping point on the Northern Pacific R.R.

**Bonners Ferry**—The annual meeting of the shareholders of the Cyanide Gold Mining Co. was held here on June 7, and was attended by shareholders from Montana, Washington and Idaho points. Official reports presented indicated the near apporach of the project to the production stage, despite many difficulties encountered in financing at present.

## COLORADO

### Ouray, Telluride, and Silverton Isolated by Floods—Cripple Creek More Active

**Ouray**—The long-delayed spring thaw has begun, and is causing much damage from floods. The Uncompahgre River is over its banks, threatening bridges and damaging property. The suspension bridge carrying the air-pipe line from the compressor to the mine of the Union property has been wrecked, and the pumphouse had to be moved to save it. The railroad brings passengers and first-class mail only to within two miles of the town, but freight and express have been abandoned. The auto and wagon road paralleling the railroad is also in very bad condition, and supplies are becoming somewhat scarce. Neighboring mining towns, particularly Telluride and Silverton, are having the same experience, being still more isolated.

**Cripple Creek**—Mining activity appears to be increasing in the district, and a number of new leasing pools have been formed recently. Numerous properties are operating two shifts per twenty-four hours. Former Cripple Creek miners have been returning from other states, and an abundant supply of labor is now available. It is the general belief that the usual mine assessment work should be done this year, so as to insure employment to many miners who might otherwise be out of work.

## CALIFORNIA

### Argonaut Mine Resumes Operations

**Jackson**—The Central Eureka is increasing the capacity of its tailings dam.

The Argonaut mine has resumed production. Unwatering of the Kennedy is expected to be completed in the near future.

**Grass Valley** — Empire Mines has shut down its Pennsylvania unit. Pumping only is being continued. About seventy-five are affected. The ore is said to be too low in grade to permit operation under present conditions.

## ARIZONA

### United Verde Extension Passes Quarterly Dividend

**Jerome**—United Verde Extension has passed its quarterly dividend for the first time since it began dividend payments in August, 1916.

**Miami**—Inspiration Consolidated has bought twenty mining claims on Pinto Creek for $44,000. These are 12 miles from Miami.

**Superior**—The Silver King of Arizona mine is to be sold by the sheriff July 6. There is a report in local circulation of the formation of a new corporation in New York to take over the old mine and to work so as to use the low-grade ores by installing a large mill.

# THE MARKET REPORT

## Daily Prices of Metals

| June | Copper, N. Y., net refinery* | Tin | | Lead | | Zinc |
|---|---|---|---|---|---|---|
| | Electrolytic | 99 Per Cent | Straits | N. Y. | St. L. | St. L. |
| 16 | 12.60@12.75 | 28.75 | 29.25@30.25 | 4.375 | 4 20 | 4.40@4.45 |
| 17 | 12.60@12.75 | 28.50 | 29.25 | 4.375 | 4.15 | 4.40@4.45 |
| 18 | 12.625 | 28.75 | 29.50 | 4.375 | 4.125 | 4.40@4.45 |
| 20 | 12.50 | 28.25 | 29.25 | 4.375 | 4.125 | 4.40@4.45 |
| 21 | 12.50 | 28.00 | 28.75 | 4.375 | 4.125 | 4.40@4.45 |
| 22 | 12.50 | 28.00 | 29.00 | 4.375 | 4.125 | 4.40@4.45 |

*These prices correspond to the following quotations for copper, "delivered": 12.85@13; 12.85@13; 12.875; 12.75; 12.75 and 12.75c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York, cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

## London

| June | Copper | | | Tin | | Lead | | Zinc | |
|---|---|---|---|---|---|---|---|---|---|
| | Standard | | Electrolytic | | | | | | |
| | Spot | 3 M | | Spot | 3 M | Spot | 3 M | Spot | 3 M |
| 16 | 72⅝ | 72⅞ | 77 | 170½ | 172¾ | 22¼ | 22 | 26¾ | 27½ |
| 17 | 71⅞ | 72⅛ | 77 | 167½ | 170 | 22⅛ | 22 | 26¾ | 27⅜ |
| 18 | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 20 | 71 | 71⅛ | 76 | 166½ | 169 | 22⅛ | 22 | 26½ | 27¼ |
| 21 | 70⅜ | 70½ | 75 | 164½ | 167¼ | 21¾ | 21⅞ | 26½ | 27 |
| 22 | 70¼ | 70¼ | 74 | 164 | 166¾ | 21⅞ | 21¾ | 26½ | 27 |

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

## Silver and Sterling Exchange

| June | Sterling Exchange | Silver | | | June | Sterling Exchange | Silver | | |
|---|---|---|---|---|---|---|---|---|---|
| | | New York Domestic Origin | New York Foreign Origin | London | | | New York Domestic Origin | New York, Foreign Origin | London |
| 16 | 379 | 99¼ | 58 | 34⅝ | 20 | 378 | 99¼ | 59⅞ | 35¼ |
| 17 | 378⅞ | 99¼ | 58⅜ | 34⅞ | 21 | 375 | 99¼ | 59¼ | 35⅛ |
| 18 | 378 | 99¼ | 59 | 35¼ | 22 | 374 | 99¼ | 58¾ | 35⅜ |

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

## Metal Markets

### New York, June 22, 1921

No improvement can be detected over the depressed conditions reported last week. Consuming demand is practically absent, and speculators are in general also holding aloof.

### Copper

Prices show a further decline, owing to pressure to sell in a stagnant market on the part of one or two small producers and some of the dealers. The larger producers are doing practically no business, as they are unwilling to sell, even to favored customers, for less than 13c. delivered, and it is understood that the largest interest of all refuses to quote under 13.5c.

Export demand has been quiet, as would be expected in view of the violent recession in exchange during the last few weeks. Germany has been the only buyer of importance through the Copper Export Association, at prices ranging from 13.50c. early in the week to 13.25c. at present. Japanese interests have been nibbling, but actual business in that quarter seems to be lacking.

### Lead

The official price of the American Smelting & Refining Co. was reduced late today from 4.50 to 4.40c. Business is reported to be slightly better but demand is still weak, and some producers report no business at all. The white-lead industry is now about the only important consumer of lead, but this business seems to be flourishing. Paint is not being used much for general industrial purposes, but seems to be in excellent demand at good prices for painting buildings. The important producers of lead are not anxious for business at present prices. Were it not for the presence of weak interests and small demand, it is almost certain that the price of lead would be much higher than at present. Production continues to decrease. Only recently the Granby smelter has closed down, and this brand is now understood to be off the market. Chemical lead is obtainable at the same price as desilverized at present, although recently it has generally commanded a slight premium. The last shipment of Spanish lead under existing contracts reached this country during the week, and it is unlikely that more will be imported, despite absence of a market in England.

### Zinc

The price has held steady, with practically all interests quoting 4.45c. St. Louis and the producer who is selling at 4.40c. getting most of the business. Galvanizers continue off the market. Despite the absence of demand, the price seems to be pretty firmly pegged at present levels. High-grade zinc is selling for 6.25c., freight allowed, a few carloads having been marketed during the week.

### Tin

A bear raid on the tin market occupied the attention of traders last Thursday and resulted in a rapid recession of the price through an unusual range. Straits tin seems to have fallen definitely below 30c. now, a condition totally unexpected a few weeks ago. Most of the consuming demand is on the part of mixed-metal manufacturers for the lower grades of tin. Sellers of 99 per cent grade are not anxious to get rid of the metal without being assured of replacements. There is practically no price differential for futures. Electrolytic is in small demand at or slightly below Straits.

Arrivals of tin, in long tons: June 15th, Buenos Aires, 60; China, 15; 18th, Buenos Aires, 53; 20th, Australia, 5.

### Gold

Gold in London: June 16th, 108s. 7d.; 17th, 108s. 5d.; 20th, 108s. 1d.; 21st, 109s. 1d.; 22d, 109s. 7d.

General stock of money in the United States: Gold coin, $3,175,037,198; standard silver dollars, $284,142,326; subsidiary silver, $271,128,299; United States notes, $346,681,016; Federal Reserve notes, $3,083,680,655; Federal Reserve Bank notes, $172,474,400; National Bank notes, $740,593,359; total, $8,073,737,253. Money in circulation, $5,983,258,293; circulation per capita,

$55.43. The gold holdings increased about $85,000,000 during May and the notes outstanding decreased about $94,000,000.

### Foreign Exchange

Exchanges strengthened somewhat during the first three days, but since Monday a recession has again occurred. On Tuesday, June 21st, francs were 8.04c.; lire, 5.005c.; and marks, 1.43c. New York funds in Montreal advanced to 13 1/16 per cent premium.

### Silver

The silver market was firm the last week, and advanced in London from 34⅝d. on June 16 to 35⅜d. on June 20 on Indian bazaars' buying. There has also been a fairly strong demand in the New York market for China shipment from San Francisco. The higher prices brought out sellers, and with buyers satisfied the market reacted and closed dull and lower. There are rumors that Germany, for reparation purposes, is trying to arrange loans against about 30,000,000 ounces of silver in various parts of the world, from which it can be inferred that the silver is not likely to be sold in a hurry, but may be sold eventually and probably through the London market. Financial interests here are not likely to tie up capital by loans on collateral which is not to be definitely liquidated. The action of the British government in respect to the surplus of silver arising from the reduction of the mint assay of silver coin is difficult to forecast. There have been some further imports of German silver to this country, which are due to the duty of 26 per cent imposed by the Reparation Act on imports of silver into England.

**Mexican Dollars**—June 16, 44½; 17th, 44⅜; 18th, 45¼; 20th, 46; 21st, 45½; 22d, 45⅝.

### Other Metals

Quotations cover large wholesale lots unless otherwise specified

**Aluminum**—List prices of 28@28.5c. are nominal. Outside market, 22@23c. per lb.; 22½c. for imports, duty paid.

**Antimony** — Chinese and Japanese brands, 5@5¼c.; market dull. W.C.C. brand, 5½@5⅝c. per lb. Cookson's "C" grade, spot, 9⅜c. Chinese needle antimony, lump, nominal at 4½c. per lb. Standard powdered needle antimony (200 mesh), nominal at 6@6½c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent $Sb_2O_3$, wholesale lots, 6½@7c.

**Bismuth**—$1.50@$1.55 per lb., 500-lb. lots.

**Cadmium**—Range $1@$1.10 per lb., in 1,000-lb. lots. Smaller quantities, $1.10@$1.25 per lb.

**Cobalt**—Metal, $4 per lb.; black oxide, $3@$3.10 per lb. in bbls.; sulphate, $1.35 per lb. in bbls.

**Iridium**—Nominal, $165@$185 per oz.

[1]**Molybdenum Metal** in rod or wire form, 99.9 per cent pure, $32@$40 per lb., according to gage.

**Nickel**—Standard market, ingot, 41c.; shot, 41c.; electrolytic, 44c. Small tonnages, spot, 35@40c.

**Monel Metal**—Shot, 35c.; blocks, 35c., and ingots, 38c. per lb., f.o.b. Bayonne.

**Osmium**—$70@$80 per troy oz.

**Palladium**—$65@$70 per oz.

**Platinum**—$75 per oz.

**Quicksilver**—Nominally, $46@$48 per 75-lb. flask. San Francisco wires $48.50.

[1]**Rhodium**—$150 per troy oz.

[1]**Selenium**—Black powdered, amorphous, 99.5 per cent pure, $2@$2.25 per lb.

[1]**Thallium Metal**—Ingot, 99 per cent pure, $20 per lb.

[1]**Tungsten Metal**—Wire, $35@$60 per kilogram, according to purity and gage.

### Metallic Ores

**Chrome Ore**—Ore analyzing 40@45 per cent $Cr_2O_3$, crude, $20@$25 per net ton; ground, $30; analyzing 45@50 per cent $Cr_2O_3$, $30; ground, $35; f.o.b. Atlantic ports. Quotations are nominal. Market very dull.

**Iron Ore**—Lake Superior ores, per ton, Lower Lake ports: Old Range bessemer, 55 per cent iron, $6.45; Mesabi bessemer, 55 per cent iron, $6.20; Old Range non-bessemer, 51½ per cent iron, $5.70; Mesabi non-bessemer, 51½ per cent iron, $5.55. Prices have been reduced $1 per ton for the 1921 season. Large stocks of ore are reported. Chief shipments are by the producer-consumer class (U. S. Steel Corporation.) Shipments of merchant ore are expected to be light.

**Magnetite Ore**—F.o.b. Port Henry, N. Y.: Old bed 21 furnace, $5.80; old bed concentrates, 63 per cent, $6.70; Harmony, cobbed, 63 per cent, $6.70; new bed low phosphorus, 65 per cent, $9.50.

**Manganese Ore** — 25c. per unit, seaport; chemical ore ($MnO_2$) $55@$60 per gross ton, lump; $70@$75 per net ton, powdered.

**Molybdenum Ore**—85 per cent $MoS_2$, 55@60c. per lb. of contained sulphide, New York.

**Tantalum Ore**—Guaranteed minimum 60 per cent tantalic acid, 50c. per lb. in ton lots.

[1]**Titanium Ores**—Ilmenite, 52 per cent $TiO_2$, 1¾@2c. per lb. for ore. Rutile, 95 per cent $TiO_2$, 12c. per lb. for ore, with concessions on large lots or contracts.

**Tungsten Ore**—Scheelite or wolframite, 60 per cent $WO_3$ and over, per unit of $WO_3$, $3@$3.25, f.o.b. Atlantic ports.

**Uranium Ore (Carnotite)**—Ore containing 1½ per cent $U_3O_8$ and 5 per cent $V_2O_5$ sells for $1.50 per lb. of $U_3O_8$ and 75c. per lb. of $V_2O_5$; ore containing 2 per cent $U_3O_8$ and 5 per cent $V_2O_5$ sells for $2.25 and 75c. per lb., respectively; higher $U_3O_8$ and $V_2O_5$ content commands proportionately higher prices.

**Vanadium Ore**—$1 per lb. of $V_2O_5$ (guaranteed minimum of 18 per cent $V_2O_5$), New York. Nominal.

[1]**Zircon**—Washed, iron free, 3c. per lb.

[1]**Zirkite**—According to conditions, $70 @$90 per ton, carload lots. Pure white oxide, 99 per cent, is quoted at $1.15 per lb. in ton lots.

[1]Furnished by Foote Mineral Co., Philadelphia, Pa.

### Zinc and Lead Ore Markets

**Joplin, Mo., June 18**—Zinc blende, per ton, high, $27.50; basis 60 per cent zinc, premium, $21; Prime Western, $20.50; fines and slimes, $20@$17.50; average settling price, all grades of zinc, $21.64.

Lead, high, $59.45; basis 80 per cent lead, $45@$40; average settling price, all grades of lead, $47.92 per ton.

Shipments for the week: Blende, 4,744; lead, 1,628 tons. Value, all ores the week, $180,670.

Lead settlements average high, on account of slow delivery of ore purchased several weeks ago, before prices began the sharp and continued decline, the basis price having receded $20 per ton in five weeks.

**Platteville, Wis., June 18**—No sales of zinc or lead ore. Shipments for the week, none. Shipments for the year: Blende, 11,461; lead, 910 tons. Shipped during week to separating plants, 338 tons blende.

### Non-Metallic Minerals

**Asbestos** — Crude, No. 1, $1,700@$2,000; No. 2, $1,200@$1,500; spinning fibers, $400@$800; magnesia and compressed sheet fibres, $275@$400; shingle stock, $95@$150; paper stock, $60@$75; cement stock, $17.50@$30; floats, $8.50@$15, all per short ton, f.o.b. Thetford, Broughton, and Black Lake mines, Quebec, Canada; 5 per cent to be added as export sales tax.

**Barytes**—Crude, 88 to 94 per cent barium content, $10@$12 per net ton; ground (white) $24@$30 in bags, carload lots; (off-color) $22@$26 in bags, carload lots; all f.o.b. South Carolina points. Foreign barytes, prime white material, $25 per net ton, f.o.b. Atlantic seaports. Western grades are $24.50. Crude quoted $7@$10 per long ton, f.o.b. Cartersville, Ga. No Southern ore shipments, because of shutdown of lithopone plants and barium chemical plants. Prices largely nominal.

**Bauxite** — French bauxite, $8@$10 per metric ton, c.i.f. Atlantic ports. American bauxite, crushed and dried, $8@$10 per gross ton, f.o.b. shipping points; pulverized and dried, $12@$15 per gross ton, depending upon grade; calcined so as to remove most of the combined water, $20 per gross ton, f.o.b. shipping point.

**Chalk**—English, extra light, 5@5½c. Domestic light, 4½@5c.; heavy, 4@4½c. per lb., all f.o.b. New York.

**China Clay (Kaolin)**—Crude, $7@$9; washed, $9@$10; powdered, $13@$20; bags extra, per net ton, f.o.b. mines, Georgia; powdered clay, $13@$20, f.o.b. Virginia points. Imported lump, $12@$20, f.o.b. American ports; powdered, $20@$30, f.o.b. New York.

**Emery**—Turkish emery, 6@6½c. per lb., depending upon fineness. Inferior grades, 3½c., f.o.b. New England points.

**Feldspar**—Crude, $7@$10 per gross ton, f.o.b. Maryland and North Caro-

lina points; $7.50@$10, f.o.b. Maine; ground, $27@$30, car lots, f.o.b. Baltimore; ground, $17@$21, f.o.b. North Carolina points; $17@$21 per ton, No. 1 ground, f.o.b. New York State; $21@$23 per ton, ground, f.o.b. Maine. No. 1 Canadian, $26@$28, f.o.b. cars. Market quiet; prices largely nominal.

**Fluorspar** — Gravel, guaranteed 85 per cent calcium fluoride and not over 6 per cent silica, $20@$22.50 per ton, f.o.b. Illinois and Kentucky mines; acid, glass, and enamel grades, $40@$55; ground, suitable for acid, chemical or enameling purposes, $32@$35; lump, $13.50, f.o.b. Lordsburg, N. M. Ground acid grade, 97 per cent $CaF_2$, $30, New Mexico. Good demand for ground grades in West. Shipments of gravel to Pacific Coast indicate improvement in Western steel business.

**Fuller's Earth**—16 to 30 mesh, $21; 30 to 60 mesh, $23; 60 to 100 mesh, $19; 100 plus mesh, $15, f.o.b. plants, Pennsylvania. California grades, $15@$25, f.o.b. mines. Imported, English, $24@$27, f.o.b. Atlantic ports.

**Graphite**—Ceylon lump, first quality, 7@7½c. per lb.; chip, 5½@6c.; dust, 3¼@4c. No. 1 flake, 6½c.; amorphous crude, ¾@2¼c. Market quiet.

**Gypsum**—Plaster of paris in carload lots sells for $4.25 per 250-lb. bbl., alongside dock, New York. Raw crushed rock, $3.50@$4.50; calcined stucco, $9; f.o.b. works, Illinois.

**Kaolin**—See China Clay.

**Limestone**—Crushed, New York State shipping points, ¾ in. size, $1.40@$1.75 per net ton; 1½ in., $1.35@$1.70. Prices for other sizes practically the same. Agricultural limestone, $2.50@$4.50 per net ton, f.o.b. eastern shipping points, depending upon analysis.

**Magnesite**, Calcined — Crude, $12@$15 per ton. High-grade caustic calcined, lump form, $30@$40 per ton. Plastic calcined, $56 in barrels, carload lots, f.o.b. California points. Atlantic seaboard, $60.

Dead-Burned — $33 per net ton, Chewelah, Wash.; $58@$64, Chester, Pa. Austrian grade, $53.80 per ton, f.o.b., Chester, Pa. (Magnesite brick—See Refractories.)

**Mica**—India block mica, slightly stained, per lb.; No. 6, 35c.; No. 5, $1.20; No. 4, $2.50@$3; No. 3, $3.50@$4; No. 2, $4.50@$6; No. 1, $5.50@$6.50. Clear block: No. 6, 50c.; No. 5, $1.75; No. 4, $3.25; No. 3, $5; No. 2, $6.50; No. 1, $8; A1, $6.50@$8.50; extra large, $25; ground, wallpaper grade, $90@$160 per ton (depending upon quantity); ground roofing mica, $25@$70, all f.o.b. New York.

[1]**Monazite** — Minimum of 6 per cent thorium oxide, quoted $30 per unit, duty paid.

**Phosphate Rock**—Per long ton, Florida ports: 77 per cent tricalcium phosphate, $12.50; 75 per cent, $11.50; 75@74 per cent, $11; 70 per cent, $6.75; 68 per cent, $6.25; 68@66 per cent, $6.

[1] Foote Mineral Co., Philadelphia, Pa.

**Pumice Stone**—Imported, lump, 3@40c. per lb.; domestic lump, 5c.; ground, 5@6c., all f.o.b. New York.

**Pyrites**—Spanish fines, per unit, 14c., c.i.f. Atlantic seaport; furnace size, 14c.; Spanish lump, 12@14c.; domestic fines, f.o.b. mines, Georgia, 12 @ 14c.

**Silica** — Glass sand, $2.25 per ton; sand-blast material, $2.25, both f.o.b. Indiana points. Amorphous or decomposed variety, soft silica, 250 to 500 mesh, $16@$30 per ton. Ganister, crude, $2.50 per ton, f.o.b. Illinois points. Molding sand, building sand, glass sand, $2.25@$3, f.o.b. Pennsylvania points. Market reported dull.

**Sulphur**—$16@$18 per ton for domestic; $18@$20 for export, f.o.b. Texas and Louisiana mines. Market quiet.

**Talc**—Paper making, $11@$20 per ton; roofing grades, $8.50@$13; rubber grades, $11@$18; all f.o.b. Vermont. California talc, $16@$35, talcum powder grade. Southern talc, powdered, carload lots, $8@$12 per ton; less than carload, $25, f.o.b. cars. Imported, $35@$40; Canadian, $20@$40 per ton.

## Mineral Products

**Arsenic** — White arsenic, 6½c. per lb. in carload lots.

**Sodium Nitrate**—$2.85@$3 per cwt. ex vessel, Atlantic ports.

**Sodium Sulphate**—For 95 per cent material, $18@$20 per ton, f.o.b. Western mines, spot and six months' contract; $33@$35 per ton, New York.

**Potassium Sulphate**—Powder, domestic, $1.50@$1.75 per unit, basis 90 per cent, f.o.b. New York.

## Ferro-Alloys

**Ferrotitanium**—For 15 to 18 per cent material, $200@$225 per ton, f.o.b. Niagara Falls, N. Y.

**Ferrocerium**—Per lb., $12@$15.

**Ferrochrome**—Carload lots, spot and contract, 60 to 70 per cent chromium, 6 to 8 per cent carbon, 14c. per lb. of chromium contained; 4 to 6 per cent carbon, 15c., f.o.b. works.

**Ferromanganese**—Domestic 76 to 80 per cent, $75@$80, f.o.b. furnace; resale, $90, delivered; English, $75@$80, c.i.f. Atlantic seaports. Spiegeleisen, 18@20 per cent, $28@$32, f.o.b. furnace.

**Ferromolybdenum**—Standard grades, carrying from 50 to 60 per cent molybdenum metal, with low sulphur, phosphorus, and arsenic, $2.50 per lb. of contained metal, f.o.b. works. Imported material, $1.70@$2.

**Ferrosilicon**—For 10 to 15 per cent, per gross ton, f.o.b. works, $40@$42; 50 per cent, $68@$72; 75 per cent, $140 @$145.

**Ferrotungsten**—Domestic, 70 to 80 per cent W, 50@55c. per lb. of contained tungsten, f.o.b. works. Foreign, 50c., duty paid, f.o.b. Atlantic ports.

**Ferro-uranium**—35 to 50 per cent U, $6 per lb. of U contained, f.o.b. works.

**Ferrovanadium**—$5@$6 per lb. of V contained, according to analyses and quantity.

## Metal Products

**Copper Sheets**—Current New York list price, 21¼@21½c. per lb.; wire, 14¼@14½c.

**Lead Sheets**—Full lead sheets, 8.25c.; cut lead sheets, 8½c. in quantity, mill lots.

**Nickel Silver** — 31½c. per lb. for 18 per cent nickel. Grade "A" sheets.

**Yellow Metal** — Dimension sheets 17¼c.; sheathing, 16¼c.; rods, ⅝ to 3 in., 14¼c.

**Zinc Sheets**—$10 per 100 lb., less 8 per cent on carload lots, f.o.b. smelter.

## Refractories

**Bauxite Brick**—56 per cent alumina, $35@$50 per ton, f.o.b. works.

**Chrome Cement**—40@45 per cent $Cr_2O_3$, $30@$32 per net ton, and $31 in sacks, carload lots, f.o.b. eastern shipping points.

**Chrome Brick**—Straights, $60@$65 per net ton, shipping point; arches, keys, wedges, $66; splits, soaps, $84.

**Fire Brick**—First quality, 9-in. shapes, $35@$40 per 1,000, Pennsylvania, Ohio and Kentucky. Second quality, $30@$35.

**Magnesite Brick**—9-in. straights, $70 @$75 per net ton; 9-in. arches, wedges and keys, $77; soaps and splits, $98, f.o.b. works.

**Silica Brick**—9-in., per 1,000: $35@$45 in carload lots, f.o.b. shipping points.

## The Iron Trade

**Pittsburgh, June 21, 1921**

Several of the larger independent mills are preparing for a shutdown of indefinite duration at the end of this month. Many small plants have been closed for several months.

The Steel Corporation's drop to a 30 per cent operating rate proves to have been only temporary, as the latest report shows a 35 per cent operation. Including in the reckoning the independent plants that are entirely idle, the average operation by the independents is about 15 per cent, making a rate for the industry of between 23 and 24 per cent. From the smallness of the flow of specifications and orders a rate of about 15 per cent may be predicted for July.

Following the recent $5 a ton decline in wire products, brought about by independent shading, the Steel Corporation following, the Republic Iron & Steel Co. has reduced its prices on black and galvanized sheets by $5 a ton. Some other independents have followed and the Steel Corporation may recognize the cut in a few days. Reduced prices do not seem to bring out more demand, and the more common view in the trade is that they had better be saved until they can be used to stimulate buyers to take hold.

**Pig Iron**—Bessemer remains quotable at $23, Valley, and foundry at $22.50, and basic is off 50c. to $21, Valley. There is practically no demand.

## Coke

**Connellsville** — Furnace, $3@$3.25; foundry, $4@$4.50.

# Census Bureau's 1919 Summary of Smelting and Refining Industries

PRELIMINARY STATEMENTS of the 1920 census of manufactures with reference to non-ferrous smelting and refining industries have been prepared by the Bureau of the Census, Department of Commerce, and are given below. It will be noted that comparisons are made on the basis of the value of the products handled. Such comparisons are liable to lead to erroneous conclusions unless it is remembered that the value of practically all commodities fluctuated and generally increased greatly during and after the war. The figures tabulated would be of greater value if the units chosen to evaluate the products were given.

### Copper Smelting and Refining

The figures are based on returns from 33 establishments, with products valued at $632,897,000. At the census of 1914 there were 37 establishments with products valued at $444,022,000, an increase of $188,875,000, or 42.5 per cent. The products include the values of the copper products of both smelters and refineries, the gold, silver, and other metallic contents of ore and bullion treated, and the sundry byproducts of the respective establishments. A number of plants temporarily suspended operations in 1919 following the close of the world war, on account of the depressed copper market. Plants idle throughout the year are not included. At the census of 1909 there were 38 establishments, with products valued at $378,806,000; in 1904, 40 establishments, and products to the amount of $240,780,000; and in 1899, 47 establishments and $165,132,000. The increases in values of products for the period 1909-1914 were 17.2 per cent; 1904-1909, 57.3 per cent; and 1899-1904, 45.8 per cent.

Quantity of copper produced at smelters, as compiled by the Geological Survey, aggregated 1,310,972,580 lb. in 1919, compared with 1,150,137,192 in 1914. Arizona leads, with 536,515,368 lb., or over 40 per cent of the total, followed, in order of rank, by Michigan, Montana, Utah, Nevada, New Mexico, Alaska, California, Tennessee, Colorado, Idaho, and Oregon.

Primary copper of domestic origin produced at refineries was 1,441,643,000 lb. in 1919, compared with 1,210,423,000 in 1914; and total refined copper, primary and secondary, of both domestic and foreign origin, is reported at 1,863,580,000 lb. for 1919, compared with 1,565,708,000 for 1914, a five-year increase of 297,872,000 lb., or 19 per cent.

The statistics for 1914 and 1919 are summarized in the following statement. The figures for 1919 are preliminary and are subject to such change and correction as may be necessary from a further examination of the original reports.

COPPER SMELTING AND REFINING—CENSUS BUREAU'S 1919 SUMMARY

| | Number of Establishments | | Value of Products | |
|---|---|---|---|---|
| | 1919 | 1914 | 1919 | 1914 |
| United States | 33 | 37 | $632,897,000 | $444,022,000 |
| Smelting only | 21 | 26 | $182,656,000 | $161,037,000 |
| Smelting and refining and refining only | 12 | 11 | 450,241,000 | 282,985,000 |
| Arizona | 10 | 9 | $94,184,000 | $53,438,000 |
| New Jersey | 4 | 4 | 244,269,000 | 159,199,000 |
| All other states | (a) 19 | 24 | 294,444,000 | 231,385,000 |

(a) Includes—California, 3 establishments; Maryland, 1; Michigan, 3; Montana, 3; Nevada, 2; New York, 1; Tennessee, 2; Texas, 1; Utah, 1; Virginia, 1; Washington, 1.

### Lead Smelting and Refining

The figures are based on returns from 25 active establishments, with products valued at $192,655,000. At the census of 1914 there were 22 establishments, with products valued at $171,579,000, an increase of $21,076,000, or 12.3 per cent. At the census of 1909 there were 28 establishments, with products valued at $167,406,000; in 1904, 32, with $185,827,000; and in 1899, 39, with $175,466,000. The values include, in addition to refined lead, the gold, silver, and copper contents of the ores and bullion treated. There is also, as in the other smelting industries, a considerable amount of duplication, as the value of products of the refineries largely duplicates that of the smelters.

Quantity of primary lead smelted or refined in 1919 as compiled by the U. S. Geological Survey was 485,612 tons, compared with 563,810 in 1914.

The statistics for 1914 and 1919 are summarized in the following statement. The figures for 1919 are preliminary and are subject to such change and correction as may be necessary from a further examination of the original reports.

LEAD SMELTING AND REFINING—CENSUS BUREAU'S 1919 SUMMARY

| | Number of Establishments | | Value of Products | |
|---|---|---|---|---|
| | 1919 | 1914 | 1919 | 1914 |
| United States | 25 | 22 | $192,655,000 | $171,579,000 |
| Smelting only | 18 | 12 | $70,973,000 | $64,695,000 |
| Smelting and refining and refining only | 7 | 10 | 121,862,000 | 107,884,000 |
| Utah | 3 | 3 | $27,518,000 | $21,752,000 |
| All other states | (a) 22 | 19 | 165,137,000 | 149,827,000 |

(a) Includes 5 in Colorado: 2 each in Illinois, Indiana, and Missouri; and 1 each in California, Idaho, Kansas, Montana, Nebraska, New York, Ohio, Oklahoma, Pennsylvania, Washington, and Wisconsin.

### Zinc Smelting and Refining

The figures are based on returns from 38 establishments, with products valued at $103,103,000, as compared with 29 establishments, and products valued at $53,538,000 in 1914, an increase of $49,565,000, or 92.6 per cent. At the census for 1909 there were 29 establishments, with products valued at $34,206,000; in 1904, 31, with $24,791,000, and in 1899, 31, with $18,188,000.

Quantity of primary zinc produced at the smelters, as reported by the Geological Survey, rose from 353,049 tons in 1914 to 465,743 tons in 1919, an increase of 31.9 per cent.

The statistics for 1914 and 1919 are summarized in the following statement. The figures for 1919 are preliminary and are subject to such change and correction as may be necessary from a further examination of the original reports.

ZINC SMELTING AND REFINING—CENSUS BUREAU'S 1919 SUMMARY

| | Number of Establishments | | Value of Products | |
|---|---|---|---|---|
| | 1919 | 1914 | 1919 | 1914 |
| United States | 38 | 29 | $103,103,000 | $53,538,000 |
| Illinois | 7 | 8 | $24,954,000 | $18,421,000 |
| Kansas | 3 | 5 | 6,038,000 | 5,259,000 |
| Oklahoma | 11 | 6 | 19,518,000 | 9,939,000 |
| Arkansas | 3 | .. | 4,423,300 | 19,919,000 |
| Colorado | 4 | 2 | 1,443,300 | |
| Other states | (a) 10 | 8 | 46,726,400 | |

(a) Includes Indiana, 2; Iowa, 1; Missouri, 1; New Jersey, 1; Pennsylvania, 3; and West Virginia, 2.

# COMPANY REPORTS

## Utah Copper Shows Net Loss

A report of operations of the Utah Copper Co. for the first quarter of 1921 states that the net production of marketable copper was 22,726,411 lb. during the period covered by the report. The average cost per net pound was 13.18c., without credit for gold and silver or miscellaneous income, including all fixed and general charges, but excluding Federal taxes and depreciation. The gold and silver and the miscellaneous income for the quarter equal 1.19c. per net pound of copper produced, which, being deducted from the operating cost, results in a net cost of 11.99c. per lb. The aforementioned per pound cost does not include charge for plant and equipment depreciation. For some time this item has been treated as an operating expense, but beginning with January of the current year it will be considered as a deduction from income. Operating statement follows:

| | First Quarter 1921 | First Quarter 1920 |
|---|---|---|
| Net profit from copper production only | $53,616.21(*a*) | $2,291,013 |
| Miscellaneous income, including payment for precious metals | 269,332.04 | 329,451 |
| Total income | $215,715.83 | $2,620,464 |
| Loss on Government bonds sold | 305,543.52 | ..... |
| Total net loss | $89,827.69 | $2,870,589(*b*) |
| Disbursement to stockholders | 1,624,490.00 | 2,436,735 |
| Net deficit | $1,714,317.69 | $433,854(*c*) |

(*a*) Loss. (*b*) Includes income from dividends ($250,125). (*c*) Surplus.

The operating loss for the first quarter is computed on the basis of 12.94c. per lb. for copper, as against a carrying price of 14.52c. for the fourth quarter of 1920. The quarterly disbursement on March 31 was $1 per share, as compared with $1.50 per share on Dec. 31 last.

## Tonopah Belmont Development Co.

A condensed statement of operations of Tonopah Belmont Development Co. for the quarter ended March 31, 1921, follows:

| | |
|---|---|
| Received and receivable for ore | $506,064.77 |
| Mining, milling and administration expenses | 426,343.63 |
| Net earnings for three months | $79,721.14 |
| Miscellaneous income | 2,999.71 |
| Dividend from Belmont Surf Inlet Mines, Ltd. | 50,000.06 |
| Total net income for three months ended March 31, 1921 | $132,720.91 |
| AVAILABLE RESOURCES, MARCH 31, 1921 | |
| Due from smelters | $211,229.88 |
| Due from others | 47,639.15 |
| Cash in banks | 230,121.63 |
| Total | $488,990.66 |

The net earnings for the quarter ended March 31, 1921, of the Belmont Surf Inlet Mines, Ltd., of which this company owns 80 per cent, were $9,822.59.

## Barnes-King Shows Profit for Quarter

The records of the Barnes-King Development Co. show the following for the quarter ending March 31, 1921:

| | | |
|---|---|---|
| Earnings: | | |
| Shannon property | | $12,653.13 |
| Interest received | | 248.22 |
| | | $12,901.35 |
| Deduct: | | |
| North Moccasin property expenses | $2,263.73 | |
| Piegan-Gloster property expenses | 2,800.01 | |
| Kendall property expenses | 177.81 | |
| Black Hawk development expenses | 2,827.02 | |
| Betsy Baker development expenses | 1,596.54 | |
| Miscellaneous expense | 1,290.22 | |
| | | 10,955.33 |
| Difference being net profit on operations for quarter ending March 31, 1921 | | $1,946.02 |

The above figures include provisions for depreciation on the same basis as has been used heretofore.

## Chino Exhibits Operating Loss

A report of the operations of the Chino Copper Co. for the first quarter of 1921 states that the net production of copper, after smelter deductions, was 8,570,034 lb., compared with 10,457,661 lb. produced during the previous quarterly period.

The cost per pound of net copper produced for the quarter, including fixed and general administrative expenses, but excluding plant and equipment depreciation and Federal taxes, for which no reserves were set up, was 14.56c., as against 13.93c. per lb. for the preceding quarter on the same comparative basis. These costs do not include credit for precious metals and miscellaneous earnings, which were 0.81c. per lb., as compared with 1.32c. for the previous quarter.

The financial results of the company's operations for the quarter are exclusive of charge for depreciation of plant and equipment, and are as follows:

| | First Quarter 1921 | First Quarter 1920 |
|---|---|---|
| Operating loss | $122,949 | $737,605 (*a*) |
| Miscellaneous income, including payment for precious metals | 69,812 | 72,122 |
| Net operating loss | $53,137 | $809,727 (*a*) |
| Distribution to stockholders | ..... | 326,243 |

(*a*) Profit.

The operating loss, as above, for the quarter is based on a price for copper of 13.13c., as compared with 14.45c. per lb. for the fourth quarter of 1920.

## Nevada Consolidated Deficit $6,634

A report of the operations of Nevada Consolidated Copper Co. for the first quarter of 1921 states that production of copper was 9,064,082 lb., compared with 10,812,729 lb. for the preceding quarter, at a cost, including all fixed and general charges, but not including Federal taxes and plant and equipment depreciation, of 13.84c. per lb., compared with 16.85c. per lb. for the previous quarter. These costs do not include credit for gold and silver or miscellaneous earnings, which amounted to 1.17c. per lb of copper, and for the previous quarter 1.33c. per lb. of copper, resulting in a net cost of 12.67c. per lb., as compared with 15.52c. average for the preceding three months.

The financial outcome of operations for the quarter is shown in the profit and loss statement below, all fixed and general items of expense, other than depreciation, being included as operating costs:

PROFIT AND LOSS

| | First Quarter 1921 | First Quarter 1920 |
|---|---|---|
| Operating loss | $112,424 | (*a*) $132,529 |
| Miscellaneous income | 105,790 | 83,054 |
| Net operating loss | $6,634 | $215,583 |
| Dividends | ..... | 499,864 |

(*a*) Gain.

The operating loss for the quarter is based upon an average carrying price for copper of 12.60c. per lb., as compared with a basing price of 14.73c. for the preceding quarter.

## Mason Valley Reports No Production

A report of operations of the Mason Valley Mines Co. for 1920 states that no metal was produced during the year. Sales of copper amounted to $237,775; cost of copper sold, $224,546; general expense, $45,590, leaving a net loss of $32,360. Other expenses, losses, and miscellaneous income resulted in a net deficit of $60,065. Surplus balance Dec. 31, 1919, was $890,419; on Dec. 31, 1921, $830,354.

# MINING STOCKS

## Week Ended June 18, 1921

| Stock | Exch. | High | Low | Last | | Last Div. |
|---|---|---|---|---|---|---|
| **COPPER** | | | | | | |
| Adventure | Boston | ¼ | ¼ | ¼ | | |
| Ahmeek | Boston | 49⅞ | 48½ | 48 | Sept. '20 Q | $0.50 |
| Alaska-Br. Col. | N. Y. Curb | ⅜ | 5/16 | ⅜ | | |
| Allouez | Boston | 22 | 20 | 20 | Mar. '19 | 1.00 |
| Anaconda | New York | 39⅜ | 36⅜ | 37 | Nov. '20, Q | 1.00 |
| Arcadian Consol. | Boston | 2¼ | 2¼ | 2 | | |
| Ariz. Com'l | Boston | 8⅛ | 8 | 8 | Oct. '18, | .50 |
| Big Ledge | N. Y. Curb | 5/16 | 3/16 | ¼ | | |
| Bingham Mines | Boston | .... | .... | 10 | Sept. '19, Q | .25 |
| Calumet & Arizona | Boston | 49½ | 46 | 48¾ | Mar. '21, Q | .50 |
| Calumet & Hecla | Boston | 242 | 235 | 235 | June '20, Q | 5.00 |
| Canada Copper | N. Y. Curb | ‡.... | .... | *13 | | |
| Centennial | Boston | .... | .... | 7⅝ | Dec. '18, SA | 1.00 |
| Cerro de Pasco | New York | 26⅛ | 25¼ | 26 | Mar. '21, Q | .50 |
| Chile Copper | New York | 10⅞ | 10⅜ | 10⅜ | | |
| Chino | New York | 24⅝ | 23⅛ | 23½ | Sept. '20, Q | .37½ |
| Columbus Rexall | Salt Lake | ‡.... | .... | *26½ | | |
| Con. Arizona | N. Y. Curb | .... | .... | 1/16 | Dec. '18, Q | .05 |
| Con. Copper M. | N. Y. Curb | .... | .... | 1⅛ | | |
| Copper Range | Boston | 34½ | 32⅛ | 33⅛ | Sept. '20, Q | .50 |
| Crystal Copper (new) | Boston Curb | *33 | *30 | *32 | | |
| Davis-Daly | Boston | 6½ | 6¼ | 6½ | Mar. '20, Q | .25 |
| East Butte | Boston | 8⅞ | 8½ | 8½ | Dec. '19, A | .50 |
| First National | Boston Curb | *58 | *53 | *53 | Feb. '19, SA | .15 |
| Franklin | Boston | 2 | 2 | 2 | | |
| Gadsden Copper | N. Y. Curb | .... | .... | *25 | | |
| Granby Consol. | New York | 20 | 17½ | 17½ | May '19, Q | 1.25 |
| Greene-Cananea | New York | 22½ | 22 | 22½ | Nov. '20, Q | .50 |
| Hancock | Boston | 2⅞ | 2⅞ | 2⅞ | | |
| Howe Sound | N. Y. Curb | .... | .... | 2¼ | Jan. '21, Q | .05 |
| Inspiration Consol. | New York | 33⅜ | 32⅛ | 32⅛ | Oct. '20, Q | 1.00 |
| Iron Cap | Boston Curb | 6⅞ | 4⅞ | 4⅞ | Sept. '20, K | .25 |
| Isle Royale | Boston | 20 | 20 | 20 | Sept. '19, SA | .50 |
| Kennecott | New York | 20 | 18½ | 18⅝ | Dec. '20, Q | .50 |
| Keweenaw | Boston | .... | .... | 1⅛ | | |
| Lake Copper | Boston | 3¼ | 3 | 3 | | |
| La Salle | Boston | .... | .... | 2 | | |
| Magma Chief | N. Y. Curb | .... | .... | *21 | | |
| Magma Copper | N. Y. Curb | 18 | 18 | 18 | Jan. '19, Q | .50 |
| Majestic | Boston Curb | *8 | *8 | *8 | | |
| Mason Valley | Boston | 1⅜ | 1⅜ | 1⅜ | | |
| Mass Consolidated | Boston | 2 | 2 | 2 | Nov. '17, Q | 1.00 |
| Mayflower-Old Col. | Boston | 3¼ | 3 | 3 3/16 | | |
| Miami Copper | New York | 21¼ | 20 | 20½ | May '21, Q | .50 |
| Michigan | Boston | .... | .... | 2 | | |
| Mohawk | Boston | 50 | 48 | 48½ | Nov. '20, Q | 1.00 |
| Mother Lode (new) | N. Y. Curb | 5¼ | 4⅞ | 5¼ | | |
| Nevada Consol. | New York | 11 | 10⅜ | 11 | Sept. '20, Q | .25 |
| New Baltic | Boston Curb | .... | .... | 3 | | |
| New Cornelia | Boston | 14⅜ | 14⅛ | 14¼ | Aug. '20, K | .25 |
| Nixon Nevada | N. Y. Curb | .... | .... | *5 | | |
| North Butte | Boston | 10 | 9¼ | 9¼ | Oct. '18, Q | .25 |
| North Lake | Boston | .... | .... | ⅜ | | |
| Ohio Copper | N. Y. Curb | .... | .... | 3/16 | | |
| Old Dominion | Boston | 21 | 20 | 20 | Dec. '18, Q | 1.00 |
| Osceola | Boston | 28 | 28 | 28 | June '20, Q | .50 |
| Phelps Dodge | Open Mar. | †160 | †150 | .... | Apr. '21, Q | 1.00 |
| Quincy | Boston | 38 | 37 | 38 | Mar. '20, Q | 1.00 |
| Ray Consolidated | New York | 13 | 12⅜ | 12⅜ | Dec. '20, Q | .25 |
| Ray Hercules | Boston Curb | .... | .... | *35 | | |
| St. Mary's Min. Ld. | Boston | 38 | 34½ | 35 | June '20, K | 2.00 |
| Seneca Copper | Boston | .... | .... | 15 | | |
| Shannon | Boston | *93 | *81 | *93 | Nov. '17, Q | .25 |
| Shattuck Arizona | New York | 6⅞ | 6 | 6⅞ | Jan. '20, Q | .25 |
| South Lake | Boston | .... | .... | 1 | | |
| Superior Copper | Boston | 3½ | 3½ | 3½ | Apr. '17, | 1.00 |
| Superior & Boston | Boston | 1⅜ | 1⅛ | 1⅛ | | |
| Tenn. C. & C. cfs | New York | 8⅛ | 7½ | 7½ | May '18, I | 1.00 |
| Toulumne | Boston | *.0 | *.55 | *.50 | May '13, | .10 |
| United Verde Ex. | Boston Curb | 26 | 21½ | 23 | May '21, Q | .25 |
| Utah Consol. | Boston | 3⅜ | 3⅜ | 3⅜ | Sept. '18, | .25 |
| Utah Copper | New York | 50⅛ | 48½ | 48½ | Mar. '21, Q | 1.00 |
| Utah Metal & T. | Boston | 1 3/16 | 1⅛ | 1 3/16 | Dec. '17, | .30 |
| Victoria | Boston | 1¼ | 1¼ | 1¼ | | |
| Winona | Boston | *50 | *50 | *50 | | |
| Wolverine | Boston | 11 | 10½ | 11 | | |
| **NICKEL-COPPER** | | | | | | |
| Internat. Nickel | New York | 15 | 13¼ | 14 | Mar. '19, | .50 |
| Internat. Nickel, pf. | New York | .... | .... | 82⅛ | May '21, Q | 1.50 |
| **LEAD** | | | | | | |
| National Lead | New York | 75 | 72⅛ | 72⅛ | Mar. '21, Q | 1.50 |
| National Lead, pfd. | New York | 102 | 101 | 101 | June '21, Q | 1.75 |
| St. Joseph Lead | New York | 10⅜ | 10⅛ | 10⅛ | June '21, Q | .25 |
| Stewart Mining | Boston Curb | .... | .... | *6 | Dec. '15, | .05 |
| **ZINC** | | | | | | |
| Am. Z. L. & S. | New York | 8½ | 8 | 8½ | May '20, | 1.00 |
| Am. Z. L. & S. pfd. | New York | 27½ | 25⅝ | 26⅝ | Nov. '20, Q | 1.50 |
| Butte C. & Z. | New York | 4⅛ | 4⅛ | 4⅛ | June '18, | .50 |
| Butte & Superior | New York | 12⅛ | 11⅝ | 12 | Sept. '20, | 1.25 |
| Callahan Zn-Ld | New York | 4⅞ | 4½ | 4⅝ | Dec. '20, Q | .50 |
| New Jersey Zn. | N. Y. Curb | 123 | 119 | 119 | May '21, Q | 2.00 |
| Success | N. Y. Curb | *2⅛ | *1⅛ | *2 | July '16, | .03 |
| Yellow Pine | Los Angeles | *55 | *55 | *55 | Sept. '20, Q | .03 |

* Cents per share. † Bid or asked. ‡Quotations missing. Q, Quarterly. SA, Semi-annually. BM, Bi-monthly. K, Irregular. I, Initial. X, Includes extra.

| Stock | Exch. | High | Low | Last | | Last Div. |
|---|---|---|---|---|---|---|
| **GOLD** | | | | | | |
| Alaska Gold | New York | ⅜ | ⅛ | ⅜ | | |
| Alaska Juneau | New York | 1⅜ | 1⅛ | 1⅛ | | |
| Carson Hill | N. Y. Curb | .... | .... | 13/16 | | |
| Cresson Consol. G. | N. Y. Curb | 1 13/16 | 1 11/16 | 1 11/16 | June '20, Q | $0.10 |
| Dome Extension | Toronto | .... | .... | *75 | | |
| Dome Mines | New York | 17½ | 16½ | 17½ | Apr. '21, Q | .25 |
| Golden Cycle | Colo. Springs | †*72 | ††70 | *71⅛ | June '21, Q | .02 |
| Goldfield Consol. | N. Y. Curb | *7 | *6 | *7 | Dec. '19, | .05 |
| Hollinger Consol. | Toronto | 7.10 | 7.05 | 7.05 | Feb. '21, M | .05 |
| Homestake Mining | New York | 55½ | 55 | 55 | May '21, | .25 |
| Kirkland Lake | Toronto | *45 | *44 | *44 | | |
| Lake Shore | Toronto | 1.19 | 1.10 | 1.18 | Jan. '21, K | .02 |
| McIntyre-Porcupine | Toronto | 1.91 | 1.89 | 1.89 | Jan. '21, K | .05 |
| Porcupine Crown | Toronto | *16 | *14½ | *15½ | July '17, | .03 |
| Portland | Colo. Springs | .... | .... | *59½ | Oct. '20, Q | .01 |
| Reorgan. Booth | N. Y. Curb | *4 | *3 | *4 | May '19, | .05 |
| Silver Pick | N. Y. Curb | *6 | *3½ | *5 | | |
| Teck Hughes | Toronto | *12½ | *11½ | 12½ | | |
| Tom Reed | Los Angeles | *80 | *70 | *78 | Dec. '19, | .02 |
| United Eastern | N. Y. Curb | 2 7/16 | 2 7/16 | 2½ | Apr. '21, Q | .15 |
| Vindicator Consol. | Colo. Springs | †*39 | †*34 | *37½ | Jan. '20, Q | .01 |
| West Dome Consol. | Toronto | *6 | *6 | *6 | | |
| White Caps Mining | N. Y. Curb | *7½ | *6 | *7 | | |
| Yukon Gold | N. Y. Curb | 1⅛ | 1 | 1⅛ | June '18, | .02½ |
| **SILVER** | | | | | | |
| Arizona Silver | Boston Curb | *21 | *16 | *19 | Apr. '20, M | .03 |
| Batopilas Mining | New York | .... | .... | ⅜ | Dec. '07, I | .12½ |
| Beaver Consol. | Toronto | *30½ | *30 | *30 | May '20, K | .03 |
| Coniagas | Toronto | .... | .... | 1.70 | May '21, Q | .12½ |
| Crown Reserve | Toronto | *12½ | *10 | *10 | Jan. '17, | .05 |
| Kerr Lake | Boston | 2⅞ | 2⅞ | 2⅞ | Apr. '21, Q | .12½ |
| La Rose | Toronto | .... | .... | *20 | Apr. '18, | .02 |
| McKinley-Dar.-Sav. | Toronto | *20 | *19 | *20 | Oct. '20, Q | .03 |
| Mining Corp. Can. | Toronto | 1.20 | 1.10 | 1.20 | Sept. '20, Q | .12½ |
| Nipissing | N. Y. Curb | 4½ | 4¼ | 4⅜ | Apr. '21, Q | .15 |
| Ontario Silver | New York | 4½ | 4½ | 4½ | Jan. '19, Q | .50 |
| Ophir Silver | N. Y. Curb | .... | .... | 2 | Jan. '12, | .10 |
| Peterson Lake | Toronto | *5½ | *5 | *5 | Jan. '17, | .01¼ |
| Temiskaming | Toronto | *21½ | *20 | *21½ | Jan. '20, K | .04 |
| Trethewey | Toronto | *16½ | *16 | *16 | Jan. '19, | .05 |
| **GOLD AND SILVER** | | | | | | |
| Atlanta | N. Y. Curb | *1 | *1 | *1 | | |
| Barnes-King | Butte | ‡.... | .... | 1.10 | Aug. '20, Q | .05 |
| Boston & Montana | N. Y. Curb | *62 | *55 | *59 | | |
| Cashboy | N. Y. Curb | *5½ | *4½ | *4½ | | |
| El Salvador | N. Y. Curb | .... | .... | ¼ | | |
| Jim Butler | N. Y. Curb | *9 | *8 | *8 | Aug. '18, SA | .07 |
| Jumbo Extension | N. Y. Curb | *6 | *4 | *5 | June '16, | .05 |
| Louisiana Con. | N. Y. Curb | .... | .... | ⅛ | | |
| MacNamara M.& M. | N. Y. Curb | *16 | *14 | *15 | May '10, | .02½ |
| N. Y. Hond. Rosar. | Open Mar. | †10½ | †9 | .... | Jan. '21, Q | .30 |
| Tonopah-Belmont | N. Y. Curb | 1 1/16 | 1 | 1 1/16 | Apr. '21, Q | .05 |
| Tonopah-Divide | N. Y. Curb | 1⅛ | 1 | 1⅛ | | |
| Tonopah-Extension | N. Y. Curb | 1 1/16 | 1⅛ | 1 1/16 | Apr. '21, Q | .05 |
| Tonopah Mining | N. Y. Curb | 1⅛ | 1 1/16 | 1¼ | Apr. '21, SA | .05 |
| West End Consol. | N. Y. Curb | 13/16 | 13/16 | 13/16 | Dec. '19, SA | .05 |
| **SILVER-LEAD** | | | | | | |
| Caledonia | N. Y. Curb | *10 | *8 | *10 | Jan. '21, M | .01 |
| Cardiff M. & M. | Salt Lake | ‡.... | .... | 1.10 | Dec. '21, | .15 |
| Chief Consol. | Boston Curb | .... | .... | 2½ | May '21, Q | .05 |
| Consol. M. & S. | Montreal | 15¼ | 14¼ | 14⅜ | Oct. '20, Q | .62½ |
| Daly Mining | Salt Lake | ‡.... | .... | 1.50 | July '20, Q | .10 |
| Daly-West | Boston | 3 | 2½ | 2½ | Dec. '20, Q | .25 |
| Eagle & Blue Bell | Boston Curb | 2 | 2 | 2 | Apr. '21, K | .05 |
| Electric Point | Spokane | ‡ | .... | *7 | May '20, SA | .03 |
| Federal M. & S. | New York | 5⅛ | 5⅛ | 5⅛ | Jan. '09, | 1.50 |
| Federal M. & S., pfd | New York | 23 | 22⅛ | 22⅛ | June '21, Q | 1.00 |
| Florence Silver | Spokane | ‡.... | .... | *12½ | Apr. '19, | .01½ |
| Grand Central | Salt Lake | ‡.... | .... | *07½ | June '20, K | .03 |
| Hecla Mining | N. Y. Curb | 4 | 3⅞ | 4 | Mar. '21, Q | .15 |
| Iron Blossom | N. Y. Curb | *20 | *16 | *16 | Apr. '20, Q | .02½ |
| Judge M. & S. | Salt Lake | ‡.... | .... | 3.00 | Sept. '20, Q | .12½ |
| Marsh Mines | N. Y. Curb | *5 | *4 | *5 | June '21, I | .02 |
| Prince Consol. | N. Y. Curb | ⅜ | ⅜ | ⅜ | Nov. '17, | .02½ |
| Rambler-Cariboo | Spokane | ‡.... | .... | *4 | Feb. '19, | .01 |
| Rex Consol. | N. Y. Curb | *8 | *7 | *7½ | | |
| South Hecla | Salt Lake | ‡.... | .... | *53 | Sept. '19, K | .15 |
| Standard Silver-Ld. | N. Y. Curb | ⅛ | ⅛ | ⅛ | Oct. '17, | .05 |
| Tamarack-Custer | Spokane | ‡.... | .... | 1.90 | Jan. '21, K | .04 |
| Tintic Standard | Salt Lake | ‡.... | .... | 2.40 | June '20, Q | .10 |
| Utah Apex | Boston | 2⅜ | 2¼ | 2⅜ | Nov. '20, K | .25 |
| Wilbert Mining | N. Y. Curb | 3 | 2 | 2½ | Nov. '17, | .01 |
| **QUICKSILVER** | | | | | | |
| New Idria | Boston | †*50 | †.... | *50 | Jan. '19, | .25 |
| **VANADIUM** | | | | | | |
| Vanadium Corp. | New York | 30½ | 26⅛ | 27 | Jan. '21, Q | 1.00 |
| **ASBESTOS** | | | | | | |
| Asbestos Corp. | Montreal | .... | .... | 58 | Apr. '21, Q | 1.50 |
| Asbestos Corp., pfd. | Montreal | .... | .... | 78 | Apr. '21, Q | 1.75 |
| **MINING, SMELTING AND REFINING** | | | | | | |
| Amer. Sm. & Ref. | New York | 39½ | 37 | 37 | Mar. '21, Q | 1.00 |
| Amer. Sm. & Ref. pf | New York | 72¼ | 70 | 70 | June '21, Q | 1.75 |
| Am. Sm. pf. A | New York | 70¾ | 70¼ | 70¼ | Apr. '21, Q | 1.50 |
| U. S. Sm. R. & M. | New York | 31¼ | 30 | 30 | Jan. '21, Q | .50 |
| U.S.Sm.R.& M. pf. | Boston | 41¼ | 40½ | 40½ | Apr. '21, Q | .87½ |

Volume 111 June 25, 1921 Number 26

# ENGINEERING AND MINING JOURNAL

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## *Contents*

*Illustrated Article

**Editorials** 1053
SUBSTITUTES AND IMITATIONS—The Exhaustion of Radium and Other Metals—The Recovery in Gold Mining—The Advantages of Exercising the Microscope—Motion Pictures of Mining Industry—The Decrease in Wages—Domestic and Foreign Business Tactics—The Institute Mining Methods Committee.

**What Others Think** 1056
SELECTIVE CONVERTING IN SOUTH AUSTRALIA—The Chloride Volatilizing Process—Chloridizing Practice in Sweden.

***Churn Drilling of Disseminated Copper Deposits—Part I** 1058
BY E. R. RICE.
FACTORS GOVERNING selection of drilling equipment, description of co-ordinate plan, qualifications of drill foremen, problems and methods of drilling, and the essential features in sampling. The author has included a complete plan for a successful drilling campaign in this paper and in the second part, which will appear in the following issue.
*Engineering and Mining Journal*, June 25, 1921.

**Sintering of Flotation Concentrates** 1064

**World's Largest Deposit of Rock Salt** 1064

***The Crahall Tailing Plant** 1065
BY W. F. BOERICKE.
DETAILS OF CONSTRUCTION AND OPERATION of a concentrator in Wisconsin designed to treat 200,000 tons of 1.75 per cent zinc tailings, making 48 per cent zinc concentrates at a cost of $16 per ton. Methods of recovering material from tailing piles discussed.
*Engineering and Mining Journal*, June 25, 1921.

**By the Way** 1069

**Consultation** 1070
THE METALLURGY OF TUNGSTEN.

**Handy Knowledge** 1071
TRIMMING A STEEL SMOKESTACK—Power Required in Gold Dredging—*Changing Skips at the Plymouth Mine—*The Plumb Bob Pocket—*Safety Attachment to Arsenic Condenser—Cleaning Linen Tracings.

**Searchlight Section** 28-29

**Directory of Engineers** 46

**The Petroleum Industry**

***Peruvian Oil Fields** 1073
BY VERNON F. MARSTERS.
FIVE PRODUCING OIL DISTRICTS are confined to the north end of the Peruvian coastal plain that borders the Andes on the west and extends to the Pacific shore line. Oil seepages are known to exist in other scetions, but no exploration has been done. A general summary of the formations and activities of each of the producing fields is given.
*Engineering and Mining Journal*, June 25, 1921.

**Petroleum in Panama** 1075

**Nova Scotia Oil Shales To Be Treated** 1075

**Technical Papers—Recent Patents** 1076

**Echoes From the Fraternity** 1077

**Personals—Obituaries** 1078

**The Mining News** 1079
THE LEADING EVENTS—Hearing of Union Sulphur Co.'s Suit Against Texas Gulf Sulphur Co. Postponed. Homestake Mining Co. Cuts Wages. Shasta Zinc & Copper Co. Starts New Plant. Report of Hecla-Bunker Hill Combination To Work Star Mine Confirmed. The New Copper Queen Mill at Bisbee, Ariz. Miners' Wages Show Decrease. NEWS FROM WASHINGTON—Fall's Statement on Mexican Petroleum Twisted. No Further Postponement of Assessment Work To Be Permitted. New Basis for Leasing Mineral Lands in Washington, Montana, and Dakotas Proposed. NEWS BY MINING DISTRICTS—United Verde Extension Passes Dividend. Silver King of Arizona's Holdings To Be Sold by Sheriff. Floods Isolate Ouray, Telluride and Silverton, Col. Activity Reported in Culiacan District, Mexico.

**Markets** 1087

**The Census Bureau Summary of Smelting and Refining** 1090

**Company Reports** 1091

**Stocks** 1092

**What and Where To Buy** 56

**Advertising Index** 62

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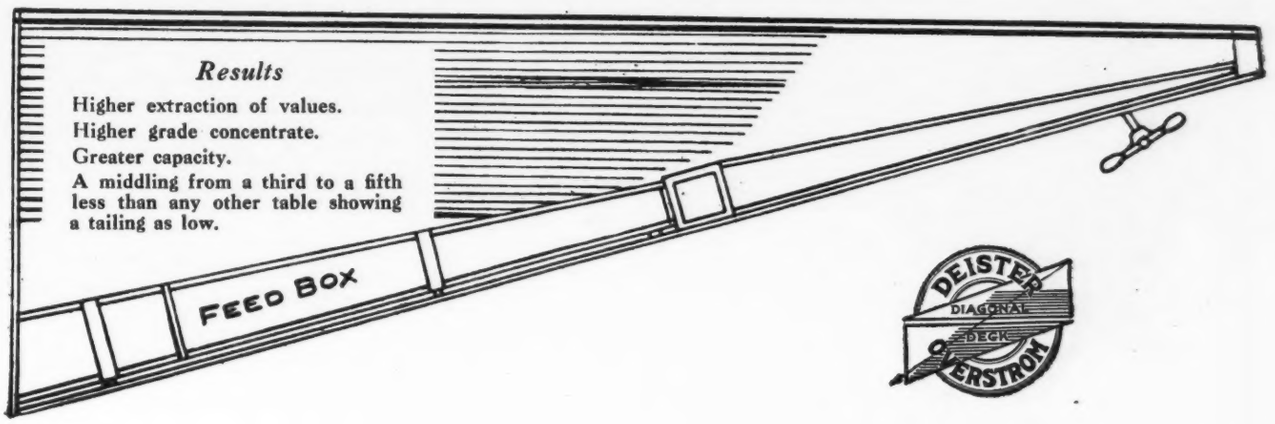


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| Stearns-Roger Manufacturing Co. | 1718-20 California St., Denver, Colo. |
| W. R. Grace & Co. | Lima, Peru (South America) |
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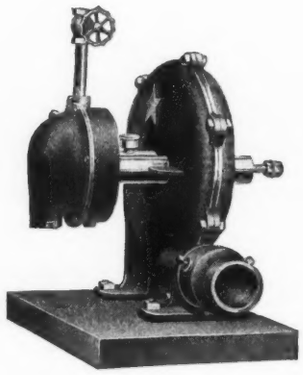


This is a direct connected blower and turbine engine that can be operated by either steam or compressed air. May be placed in any position and operated by simply connecting to a boiler or compressor.

The exact blast required can be readily obtained by means of a globe valve which regulates the speed of the turbine.

The light weight of this blower makes it a favorite among miners.

### Buffalo Volume Exhauster

**For Ventilating, Removing Smoke, Fumes, Gases, Etc.**

The application of Buffalo Volume Exhausters for ventilating, removing smoke, fumes, gases, etc., has been most extensive and satisfactory. They have a wide application of uses in every line of industry and are extensively used in mines and mills.

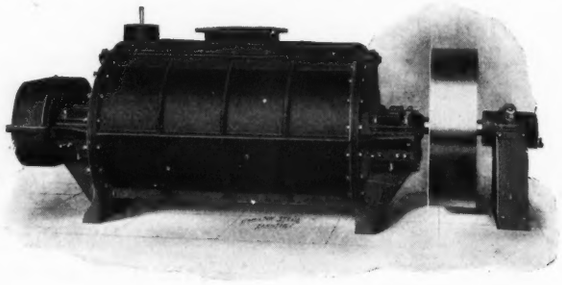
The shell is cast iron and the entire construction is of high grade order. The fan is of extra quality. Provided with extra long journal bearings of the ring-oiling type, and particularly suited for use where dust, dirt and grit fill the air.

All parts are easily accessible.

### Roots Positive Pressure Blower

**For Flotation, Agitation of Liquids, Foundry Cupolas, Oil and Gas Furnaces, Etc.**

Roots Blowers are designed to meet any capacity or condition of operation being successfully applied to any service demanding air at pressures ranging from ½ pound to 15 pounds per square inch.



The design and workmanship are of the very best in every respect. Furnished with improved, single wedge, adjustable, self-oiling bearings, single geared with oil-tight oil housing and single pulley.

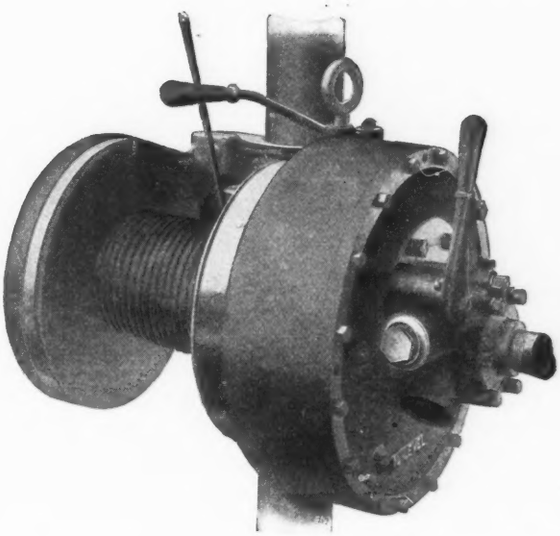
Built in both the horizontal and vertical types.

**We Have Blowers or Exhausters for Any of Your Requirements**

## The Hendrie & Bolthoff Mfg. and Supply Co.

**Opposite Union Station** **Denver, Colorado**

*"For 60 Years"*



# Here's Your Hoist

YOU'VE been waiting for an air-hoist with more speed, greater power and capacity, higher efficiency, and one that would use less air.

WELL, here's your hoist at last — The Waughoist. Driven by an entirely new type of almost frictionless rotary engine, the Waughoist will solve every lifting problem in your mine in a completely satisfactory manner and at the same time materially reduce your operating costs.

LET us tell you more about this remarkable new machine. Send for a Waughoist booklet today.

THE Denver Rock Drill Manufacturing Co.

Denver, Colorado

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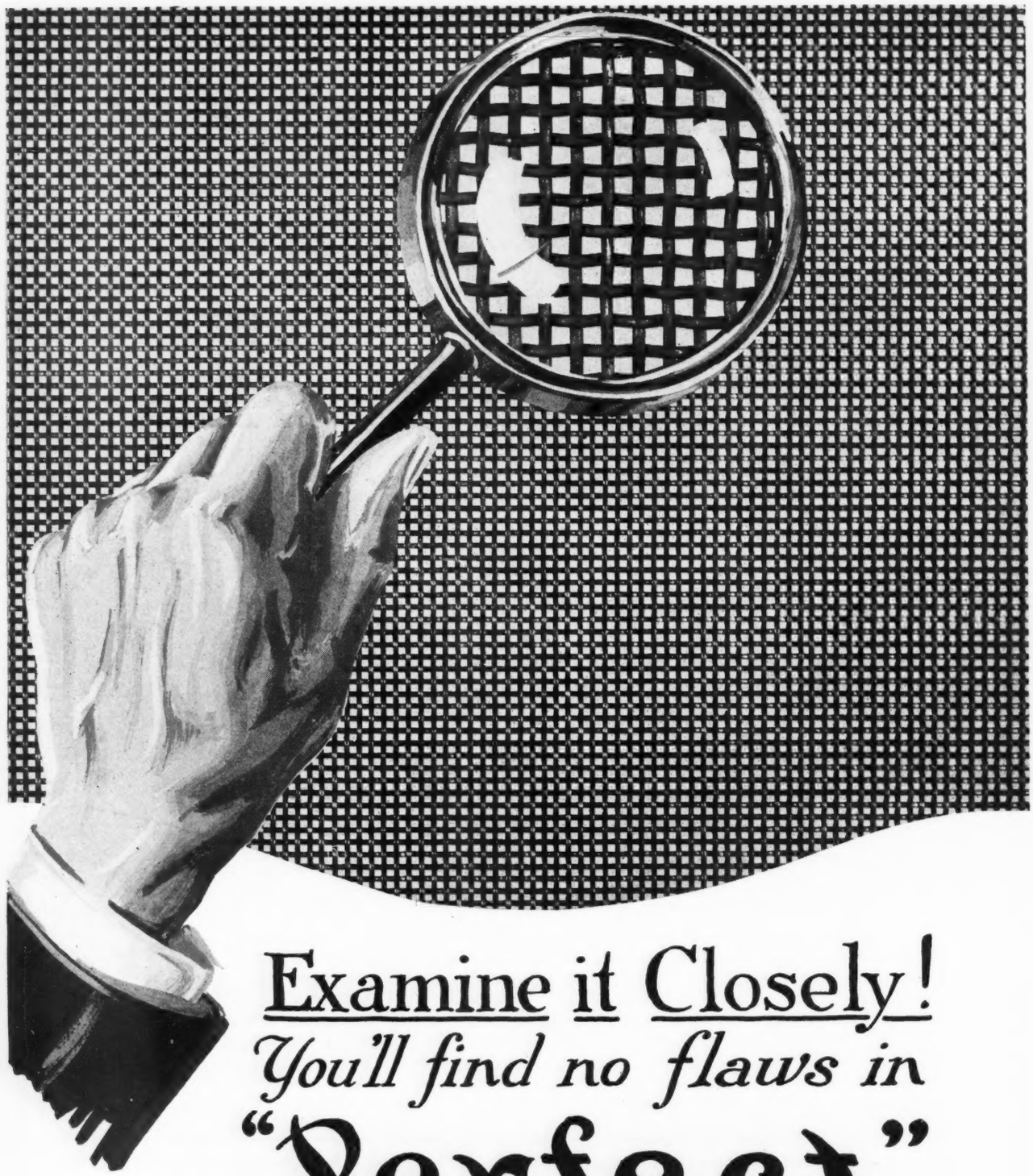


Examine it Closely!

You'll find no flaws in

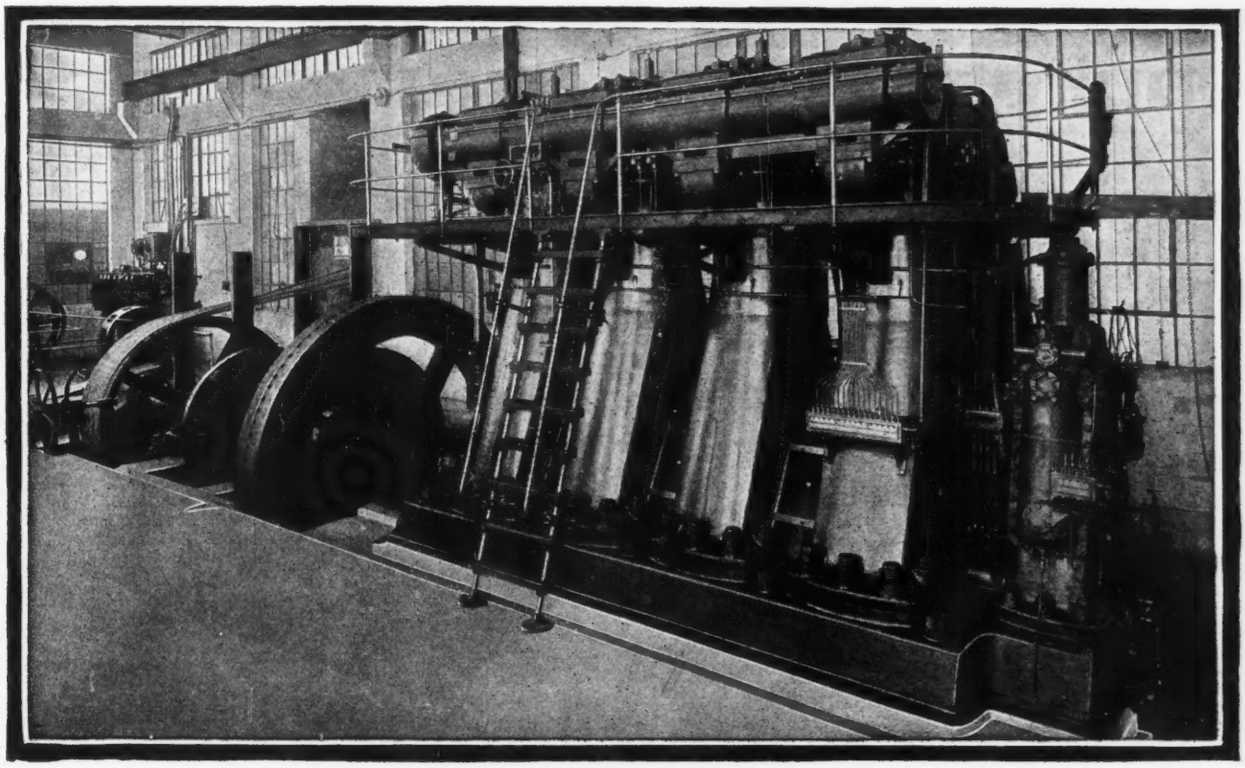
"Perfect"

Double Crimped Wire Cloth

and REK-TANG Screens

Made by The Ludlow-Saylor Wire Company

at St. Louis, Missouri, U.S.A.



# Save the Expense of Power Plant Auxiliaries

## with a Self-Contained Prime Mover

You want reliable power at the least possible cost.

You don't even have to figure to see the big savings in dollars and cents in a Fulton Diesel Oil Engine. Fulton Diesel means a self-contained prime mover. The elimination of boilers, condensers, stacks, heaters and all auxiliary steam power plant equipment, gas producers, etc., means that it works in a straight line instead of in a circle. You get power direct from fuel, through internal combustion.

Obviously, you save—in the space required for the power plant—in labor and expense of handling the fuel.

You do this with an engine that operates in many cases on more than two-thirds less fuel than a steam plant—an engine that has the highest thermal efficiency of any prime mover known—an engine that has proved its high economy over widely varying loads—an engine that is dependable beyond all question for continuous heavy duty service.

The massive "A" frames typify the strong and durable character of the Fulton Diesel Engine.

With all wearing parts of working surfaces removable and replaceable, the engineer finds it an easy matter to maintain the perfect mechanical condition of the engine for years.

***Things to Remember about the Fulton Diesel***

A self-contained power plant. Built for general power purposes in units from 150 to 1,000 horsepower. Saves in many cases more than two-thirds of the fuel cost of burning fuel under boilers. Thermal efficiency of 36 per cent net against an average maximum of 16 per cent for steam. A fuel consumption in almost direct proportion to the load. Small volume of cooling water required. Uses cheap fuel. In constant readiness for operation. Reliable 24-hour-a-day service. Economy independent of its size. Long life with practically undiminishing efficiency. Any capable steam plant engineer finds it readily responsive to his care.

*Our new bulletin No. 801, gives a description of the Fulton Diesel Engine with illustrations and photographs of a number of installations. Write for it.*

**FULTON IRON WORKS COMPANY, St. Louis, U. S. A.**

*Branch Offices:* New York, 82 Wall St. Cuba, Havana, 401-402 Banco-Nacional

*Successful Engine Builders for 69 Years*

# FULTON

## DIESEL ENGINES

# PROVING OIL STRUCTURE

*with*

## Sullivan Diamond Drills

***A Message to Oil Producers***

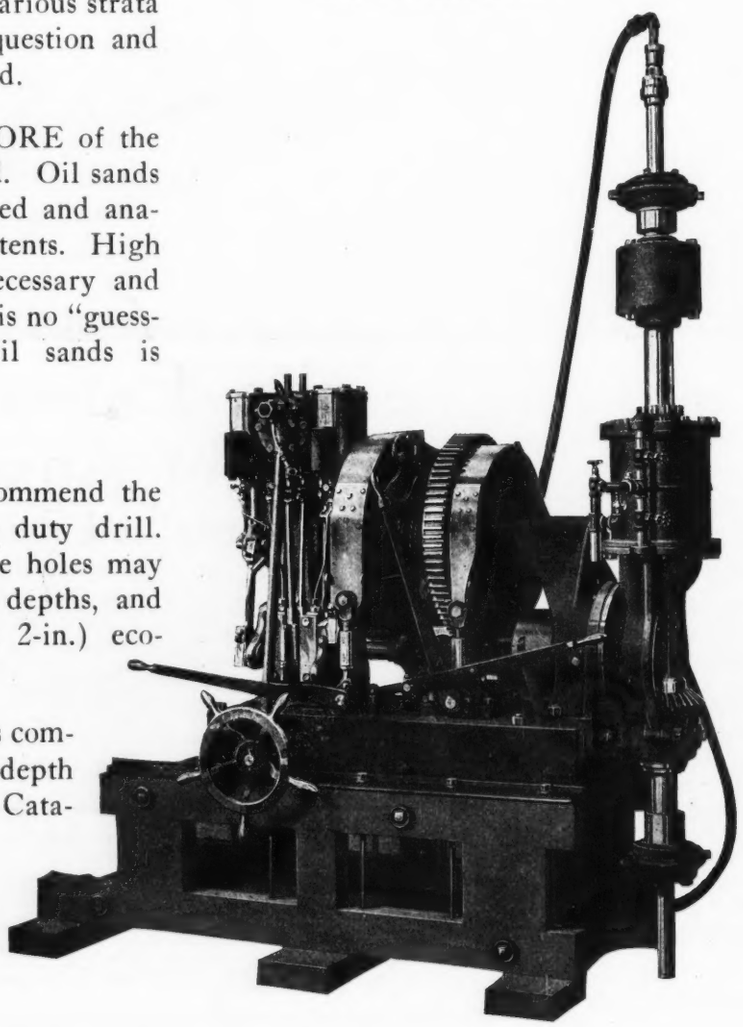
Modern methods of testing oil bearing formation call for exact information on geological conditions. The various strata must be identified beyond question and elevations must be determined.

A DIAMOND DRILL CORE of the formation is a perfect record. Oil sands in this form may be examined and analyzed for porosity and oil contents. High expensive derricks are unnecessary and casing costs are low. There is no "guesswork," and sealing off oil sands is avoided.

For oil prospecting we recommend the Sullivan Class "P" heavy duty drill. With this perfected machine holes may be drilled rapidly to great depths, and cores of large size (up to 2-in.) economically recovered.

One of these "P" drills has completed an oil prospect to a depth of 5000 ft. in Oklahoma. Catalogue 269.

*If you want to contract your oil drilling ask us for prices.*



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**126 SO. MICHIGAN AVENUE, CHICAGO, ILLINOIS U.S.A.**

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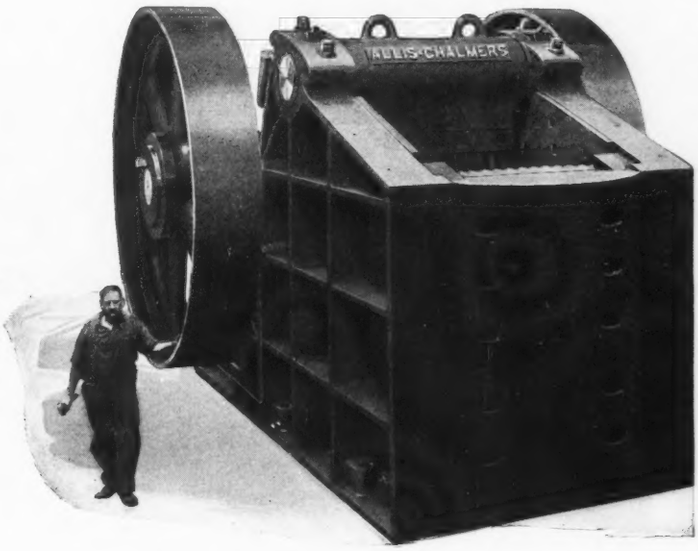
**Air Compressors; Air Lift Pumps; Diamond Drills; All-Hammer Drill Sharpeners; Drill Steel Furnaces; Forge Hammers; Ironclad Coal Cutters; Rock and Hammer Drills; Quarrying Machinery; Contractors for Diamond Core Drilling.**

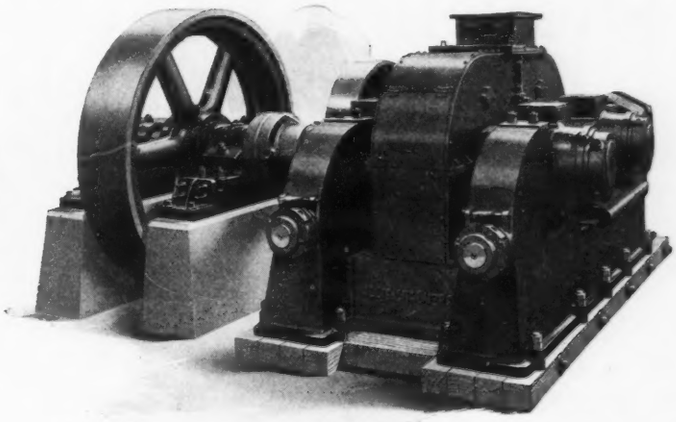
# ALL STEEL JAW CRUSHERS
## AND
# XX STRAIGHT LINE CRUSHING ROLLS




All-Steel Jaw Crusher

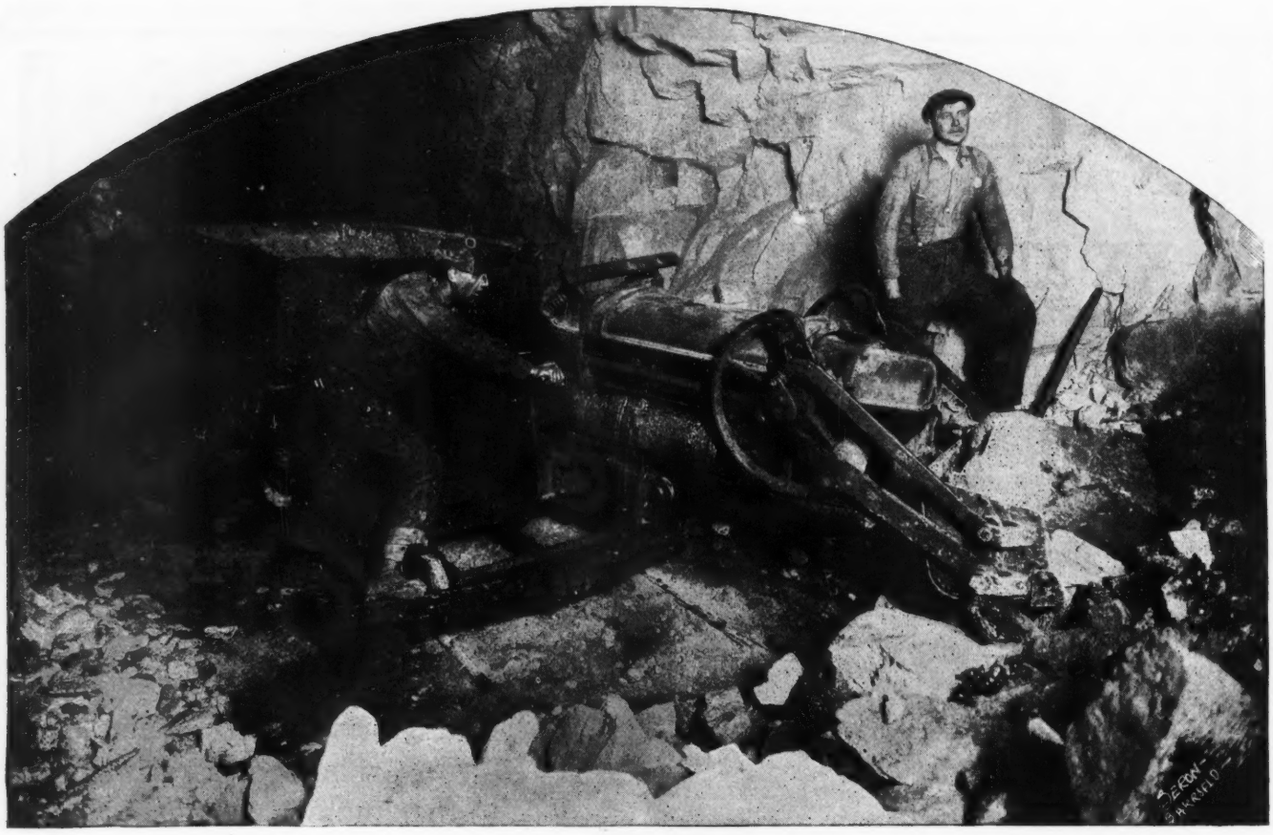
The massive construction of the ALLIS-CHALMERS All Steel Jaw Crushers and XX Straight Line Crushing Rolls indicates machines that are built for heavy work and severe service. All the latest improvements are embodied, assuring maximum efficiency and economy.

**Bulletins**
**All Steel Jaw Crushers**
**No. 1810**
**XX Straight Line**
**Crushing Rolls**
**No. 1816**



72 in. x 24 in. Style XX Straight Line Crushing Rolls

# ALLIS-CHALMERS
MILWAUKEE, WIS. U. S. A.



*Shuveloder and crew at work in Kern Canyon Tunnel, Edison, California*

# Shoveling 17½ tons per hour per Shuveloder

SIX SHUVELODERS are mucking the coarse breaking granite from twelve headings in the Kern Canyon tunneling project. The following is a summary taken from a detail time study—an average of what each is actually doing.

SUMMARY

| | |
|---|---|
| Total Time (Including 30 mi. lunch period) | 8 hrs. 55½ mi. |
| Total Time actually loading | 4 hrs. 55½ mi. |
| Average loading time per car (3 tons) | 5 mi. 41 sec. |
| Average waiting time per car | 4 mi. 36 sec. |
| Total Tons Loaded | 156 |
| Tons per hour (Total Time) | 17½ |
| Tons per Hour (Loading Time) | 31¾ |
| Tunnel—Enlargement of a 6 ft. x 6½ ft. tunnel to 14 ft. x 14 ft. | |
| Depth of holes drilled | 16 ft. |

If you are driving tunnels, drifts or cross cuts you have a positive need for Shuveloders. Hand loading is costly. DO IT MECHANICALLY—the only way to reduce loading costs and to speed up the work. ***Send for Catalogue 4-E.***

## Lake Superior Loader Company, Duluth, Minnesota

**Eastern Office**
**50 Church St.**
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**Sharon Bldg.**
**San Francisco**

# Shuveloder

**"The mechanical mucker"**

# REMCO

## 16 miles across the desert

—bringing pure mountain water to the city of Phoenix, Arizona, in 36-inch and 38-inch diameter Remco Continuous Stave Redwood Pipe.

Not a difficult job for Remco. We've been constructing difficult pipe jobs for 32 years.

***Ask for the new reduced prices.***

**Redwood Manufacturers Co.**

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# Mushrooms and Toadstools

"STEVE" says that, "mushrooms *resemble* toadstools but an actual try-out reveals a vast difference."

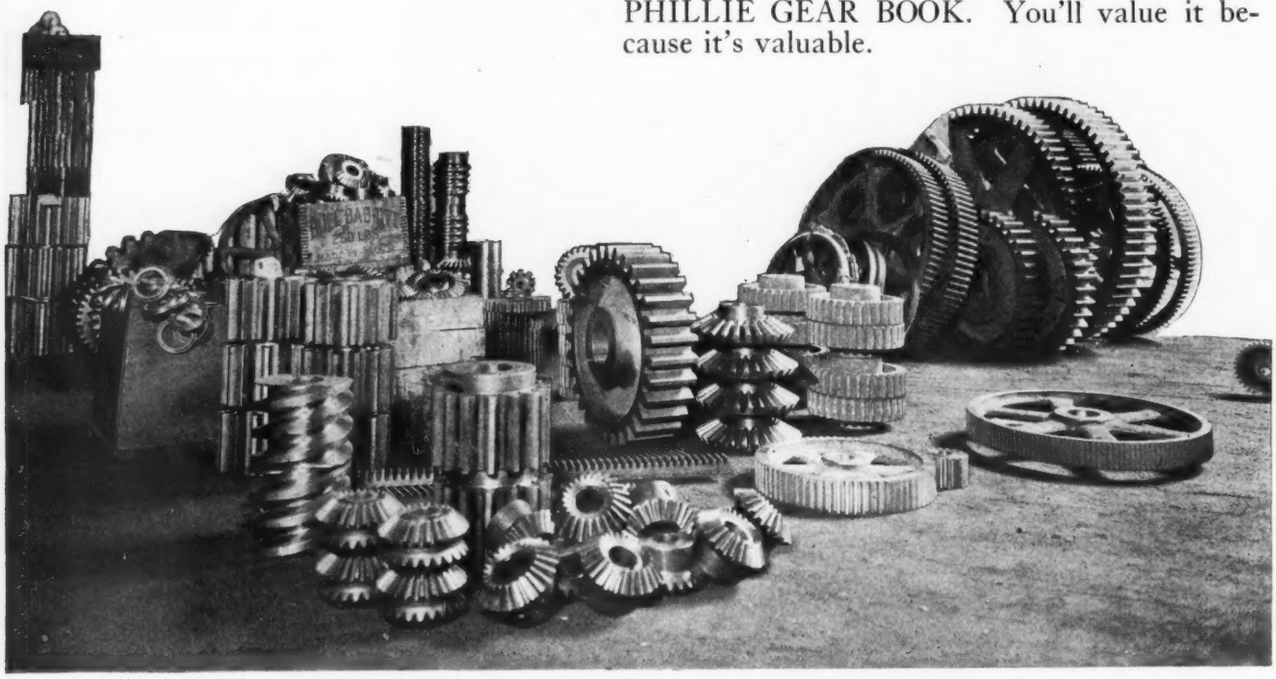
It's the same way with gears. One gear may *resemble* another but in every-day service you can tell a Philadelphia GEAR from any other gear.

There are a number of good, sound reasons why GEARS Philadelphia are superior. Deep seated pride in producing the best is the biggest factor in our organization. We use extreme care in selecting our machines and the same rule goes in employing mechanics.

As the exhibit below will prove, we are in position to cut anything with teeth. We can cut it to the closest limits and cut it in a time that's sure to please.

Just try us on the next breakdown or other rush job. On some styles of gears you'll receive your order within 24 hours. On any gear the time is sure to please because your troubles become ours when the emergency arises.

In order to avoid mistakes and delay when in need of gears, send in your request for the PHILLIE GEAR BOOK. You'll value it because it's valuable.



Spur — Bevel — Mitre — Spiral — Worm — Helical

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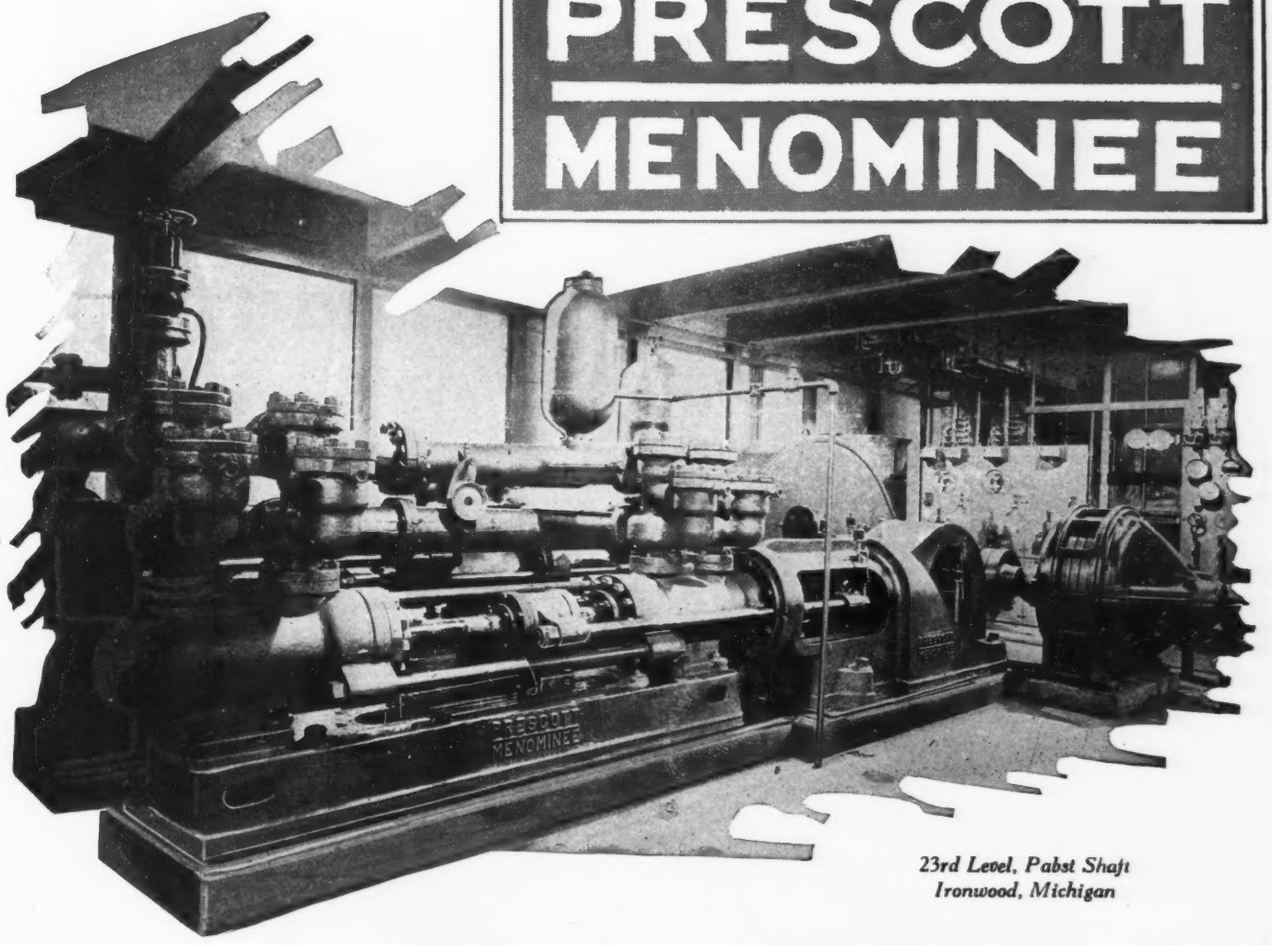
**PRESCOTT**
**MENOMINEE**




*23rd Level, Pabst Shaft*
*Ironwood, Michigan*

# *Station Pumps in the Pabst Shaft*

THERE'S no shambling or relaying of water with Prescott-Menominee Pumps and this installation in the Pabst Shaft of the Oliver Iron Mining Co., Ironwood, Michigan, is no exception.

Here each, for there are two, 4⅞" x 24" electrically driven Prescott-Menominee Pumps is delivering, direct to the surface, 400 gallons per minute and working against a 1700-foot head.

We specialize in Electric Pumps for deep mines and would welcome an opportunity to discuss your pumping problems with you.

**400 Gallons per Minute**

**Head 1700 ft.**

## THE PRESCOTT COMPANY

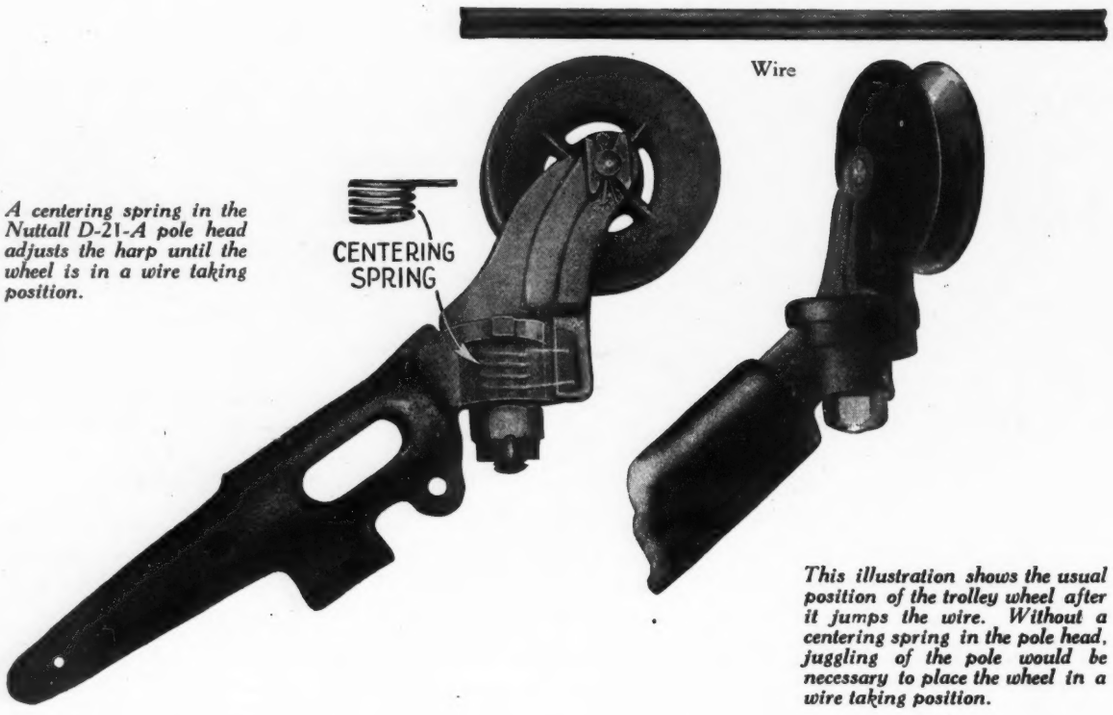
**FRED M. PRESCOTT, President**

**Menominee, Michigan**

# Nuttall

## D-21-A Pole Head and Harp

### *for Mine Trolleys*




*A centering spring in the Nuttall D-21-A pole head adjusts the harp until the wheel is in a wire taking position.*

*This illustration shows the usual position of the trolley wheel after it jumps the wire. Without a centering spring in the pole head, juggling of the pole would be necessary to place the wheel in a wire taking position.*

The advantage of the Nuttall D-21-A pole head is that, although it has a swivel harp, yet the wheel is always in a wire taking position when the trolley is off the wire.

When the trolley wheel leaves the wire a centering spring in the pole head (see Fig. 1) automatically adjusts the harp until the groove of the wheel is in a straight line with the axis of the pole, or in a wire taking position.

The D-21-A pole head and harp are light and strong and with the combined features of the swivel and centering spring will save much time and worry to the motorman as well as improve operating conditions.

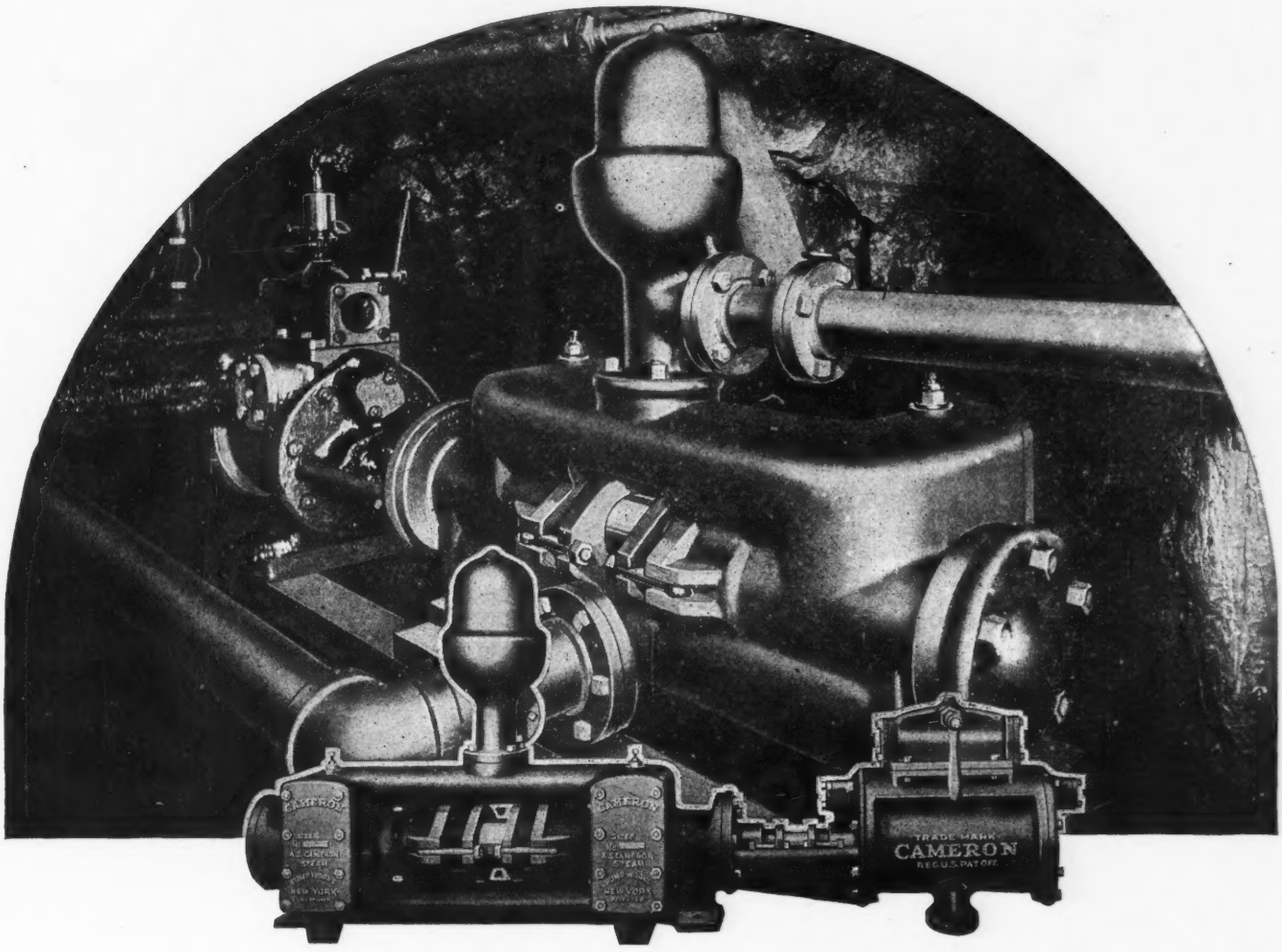
D-21-A pole head can be used on any standard make of mine trolley pole.

*Write for Catalog No. 15.*

R.D. NUTTALL COMPANY
PITTSBURGH PENNSYLVANIA

All Westinghouse Electric and Mfg. Co. District Offices are Sales Representatives in the United States for Nuttall Electric Railway and Mine Haulage Products

# Heedless of neglect, regardless of age, and indifferent to character of work




# CAMERON SINGLE PUMPS

The outside packed plunger pump, shown above, is especially adapted for station duty in mines where gritty water must be handled. There are no wearing parts in the water end except the packing in the stuffing boxes, which can be adjusted from the outside.

Cameron Pumps are built for hard service. They are strong, durable and simple. Write for Bulletin 7304.

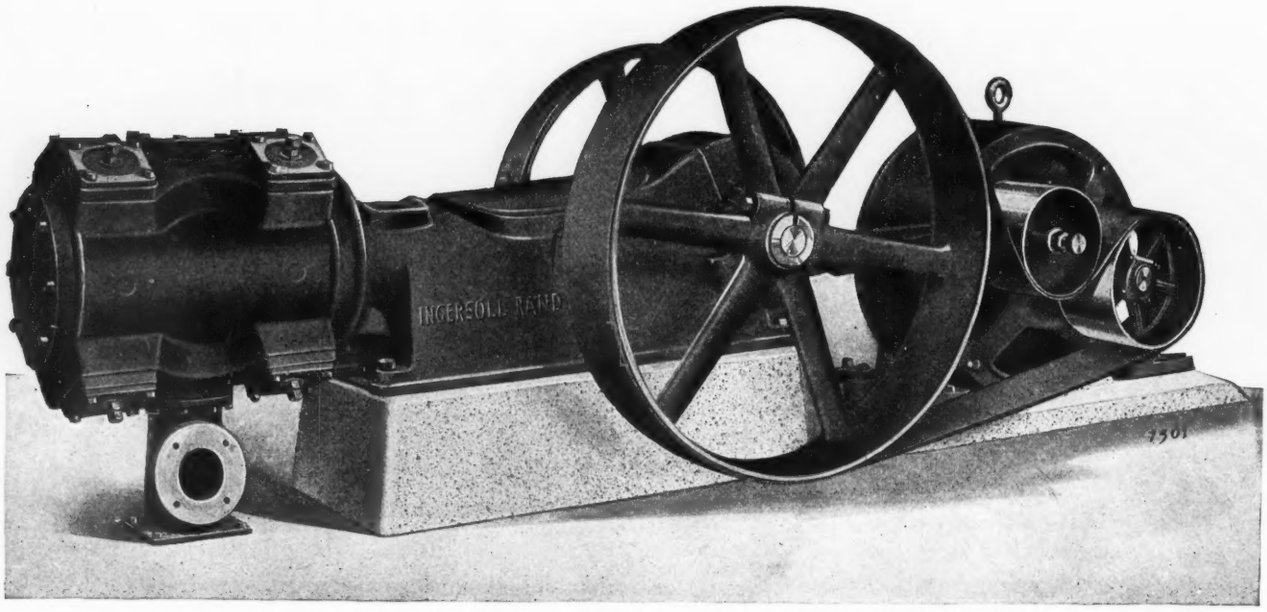
PRICE OIL ENGINES

**INGERSOLL-RAND COMPANY**
**11 Broadway, New York**
*Offices Everywhere*

106-S

# Ingersoll-Rand

**The A. S. Cameron Steam Pump Works**




# *A solution to your compressor problem*

No two compressor installations involve exactly the same problems. Questions of capacity, discharge pressure, regulation and type of drive are different in each case.

But before any compressor is bought the purchaser should know how much it will cost him per cubic foot to compress the air, and how long he can be sure of freedom from breakdown and decreased efficiency. In other words, take into account the operating costs, and go back to the coal pile or switchboard.

Ingersoll-Rand Compressors are not only built to deliver the air cheaply but to deliver it when you want it. Whether the unit be for only 3 cu. ft. per minute or one of our larger reciprocating or turbine units of 10,000 cu. ft. capacity, the name Ingersoll-Rand on that compressor means reliable service.

Above is shown a class "ER" straight line, single stage compressor. This type is enclosed, dust-proof and automatically lubricated. The completely water-jacketed air cylinder is fitted with quiet plate valves. The foundation is simple, and the necessary floor space small, especially if the I-R short belt attachment is used.

Class "FR" steam driven machines are similar, but in this case the air cylinder is direct-connected to a piston valve steam engine.

***Let us send you copies of Bulletins Nos. 3330 and 3131 describing these "ER" and "FR" compressors, or descriptive literature of our other sizes and types***

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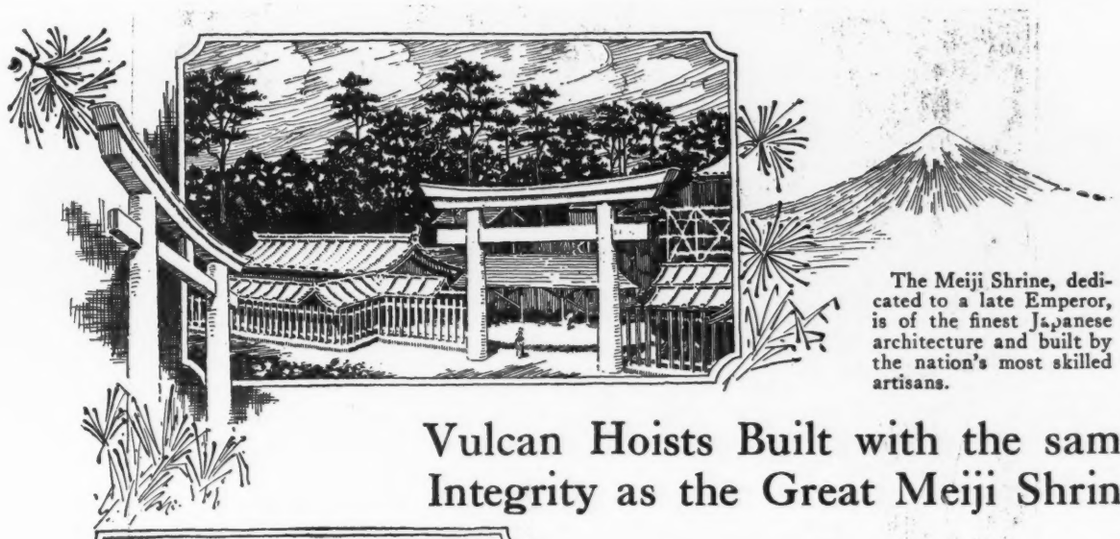
PRICE · IR · OIL ENGINES

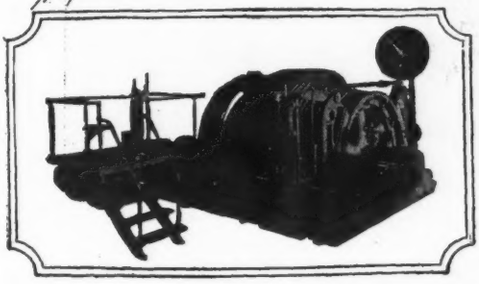
# Ingersoll-Rand

**OIL ENGINES PNEUMATIC TOOLS CONDENSERS**

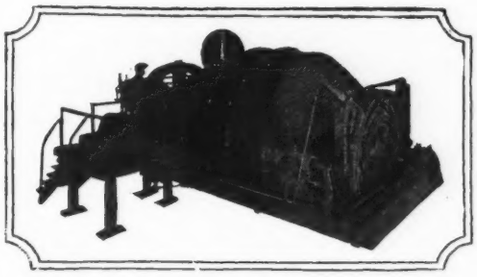


The Meiji Shrine, dedicated to a late Emperor, is of the finest Japanese architecture and built by the nation's most skilled artisans.

# Vulcan Hoists Built with the same Integrity as the Great Meiji Shrine



400 h. p. hoist with 7 ft. to 10 ft. diameter double cylindro-conical drum large enough to wind 1200 ft. of 1¼ in. rope in one layer. This hoist has a capacity of 500 tons of coal in 8 hours.



400 h. p. hoist with two cylindro-conical drums, 8 ft to 14 ft. diameter, one tight and one loose for hoisting in balance from different levels. Each drum is large enough to wind over 2000 ft. of 1¼ in. rope. Output, 400 tons in 8 hours from maximum depth.

AS in the great Meiji Shrine, the integrity that comes from a purpose to build most skillfully and of the best material is revealed in the perfection of Vulcan products.

The hoists illustrated were built for use in Japan. The coal operators and mining engineers of our own country have long known the merits of Vulcan hoists and foreign engineers now also realize their worth.

A hoist never leaves the Vulcan shop until its ability to perform the duty for which it was designed is absolutely assured.

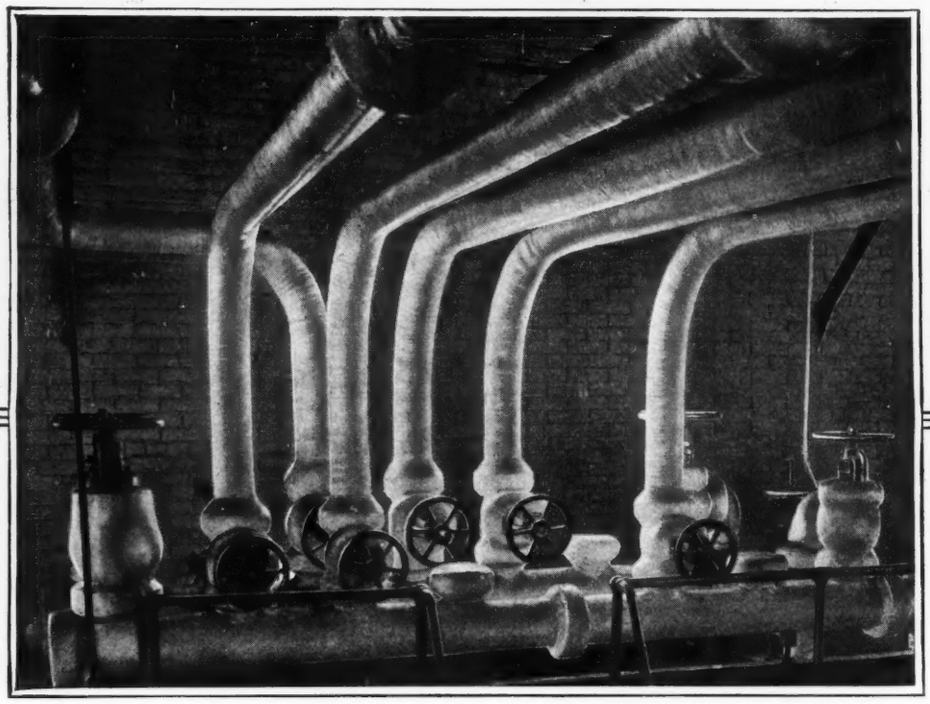
Vulcan engineers are ready to co-operate with you.

VULCAN IRON WORKS

*Established* 1849

1733 Main Street, Wilkes-Barre, Pa.

**VULCAN OF WILKES-BARRE HOISTS**



**A properly designed system installed with**

# CRANE
# Piping Equipment

**insures safety, reliability, and a minimum maintenance cost.**

We are manufacturers of about 20,000 articles, including valves, pipe fittings and steam specialties, made of brass, iron, ferrosteel, cast steel and forged steel, in all sizes, for all pressures and all purposes and are distributors of pipe, heating and plumbing materials.

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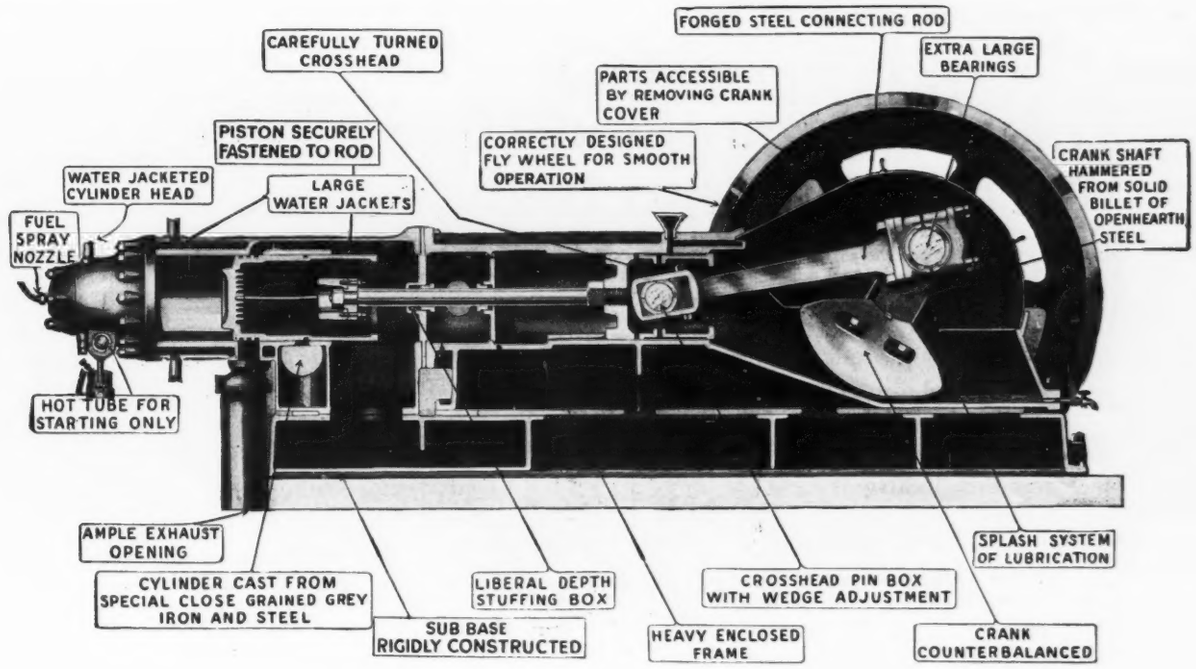

FORGED STEEL CONNECTING ROD
CAREFULLY TURNED CROSSHEAD
EXTRA LARGE BEARINGS
PARTS ACCESSIBLE BY REMOVING CRANK COVER
PISTON SECURELY FASTENED TO ROD
CORRECTLY DESIGNED FLY WHEEL FOR SMOOTH OPERATION
CRANK SHAFT HAMMERED FROM SOLID BILLET OF OPENHEARTH STEEL
WATER JACKETED CYLINDER HEAD
LARGE WATER JACKETS
FUEL SPRAY NOZZLE
HOT TUBE FOR STARTING ONLY
AMPLE EXHAUST OPENING
CYLINDER CAST FROM SPECIAL CLOSE GRAINED GREY IRON AND STEEL
LIBERAL DEPTH STUFFING BOX
SUB BASE RIGIDLY CONSTRUCTED
CROSSHEAD PIN BOX WITH WEDGE ADJUSTMENT
HEAVY ENCLOSED FRAME
SPLASH SYSTEM OF LUBRICATION
CRANK COUNTERBALANCED

# *The inside construction of Giants will bear as close scrutiny as their outside reputation*

USERS have learned from actual experience that Giant Semi-Diesel Oil Engines stand alone on the basis of *dependability* and operating economy.

And the attendants of these engines have learned that Giants, due to their rugged simplicity, are practically independent of the human factor.

Giant Oil Engines are preferred because they possess the greatest number of *advanced* features of construction. This statement is confirmed by their inside construction features illustrated above.

Each feature shown does a *necessary* job in delivering power at lowest possible costs, contributing to an indefinitely long service life, every-day dependability, and operating simplicity that lessens attendant costs.

On a basis of year-in and year-out worth, fuel economy, lowered upkeep and attendant costs—how much can Giants save in *your* plant? How soon could a Giant pay for itself? If you wish, a C-P sales engineer will help you find out.

Ask for Bulletin 389.

## Chicago Pneumatic Tool Company

**Chicago Pneumatic Building · 6 East 44th Street · New York**

*Sales and *Service Branches all over the World*

*Birmingham *Boston *Buffalo *Chicago *Cincinnati *Cleveland *Detroit El Paso Erie Franklin Houston Joplin *Los Angeles *Minneapolis *New Orleans *New York *Philadelphia *Pittsburgh Richmond Salt Lake City *San Francisco *Seattle *St. Louis Basle *Berlin Bombay Brussels Buenos Aires Christiania Copenhagen *Fraserburgh Havana Helsingfors Honolulu Johannesburg *London Manila Milan Montevideo *Montreal Osaka Paris Rio de Janeiro *Rotterdam Santiago Sao Paulo Seoul Shanghai Tientsin Tokyo Toronto Vancouver Winnipeg

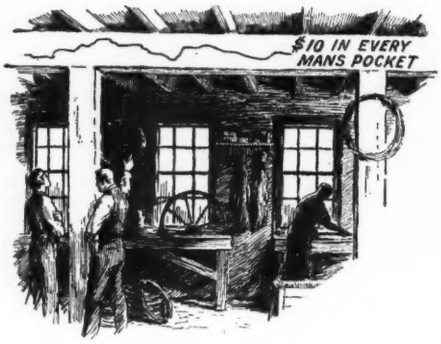
EN 43

BOYER PNEUMATIC HAMMERS · · LITTLE GIANT PNEUMATIC AND ELECTRIC TOOLS
CHICAGO PNEUMATIC AIR COMPRESSORS · · VACUUM PUMPS · · PNEUMATIC HOISTS
GIANT OIL AND GAS ENGINES · · ROCK DRILLS · · COAL DRILLS

# GIANT ENGINES

*Dependable Power at* — *Less Cost Per Hour*

# Erskine Hazard and His Partner Were the First to Reduce the Price of Anthracite Coal




After Erskine Hazard and Josiah White had discovered how to burn anthracite coal in their wire mill, which was then located in Philadelphia, and thus established its use in 1814, they desired some way to get it down from the mines to the city more economically than in wagons. Anthracite coal at that time was selling at one dollar a bushel ($28 per ton).

They planned a canal system to be operated in conjunction with the Schuylkill River and to illustrate their project, drew a plan with chalk on one of the beams of their mill and wrote under it, "Ten dollars in every man's pocket," —meaning that that amount would be saved in the cost of coal to all users.

The scheme proved successful and the Schuylkill Navigation Company was organized in 1815. Three years later the Lehigh Navigation Company and the Lehigh Coal Company were formed to develop the Lehigh coal fields simultaneously. Two years later both companies were merged into the Lehigh Coal and Navigation Company.

So it was that these two men not only established the value of an unappreciated fuel, but lowered its cost and formed the "Old Lehigh" company which still mines and markets Lehigh anthracite.

This is one more indication of the vision that the founder of the Hazard Manufacturing Company had of the future. And the soundness of his basic, enduring principles still influences the making of HAZARD Wire Rope.

**HAZARD MANUFACTURING COMPANY**

NEW YORK PITTSBURGH CHICAGO
DENVER BIRMINGHAM

Wilkes-Barre, Pa.

**HAZARD Wire Rope**

1812 1921

# TELSMITH'S LONG INITIAL CRUSHING STROKE

The striking success of the Telsmith Primary Breaker is due principally to the PARALLEL GYRATION OF THE HEAD. The eccentric is inside the crushing cone, acting directly on it. This long sleeve eccentric imparts to the head the same gyratory stroke as in a lever-shaft crusher; but the Telsmith stroke is *uniform at the top and bottom of the bowl.* For instance, in a No. 7½ Telsmith Breaker the eccentric throw is 11-16 in. This eleven-sixteenth pinch is *applied to the big chunks, the very second day they fall into the bowl.*

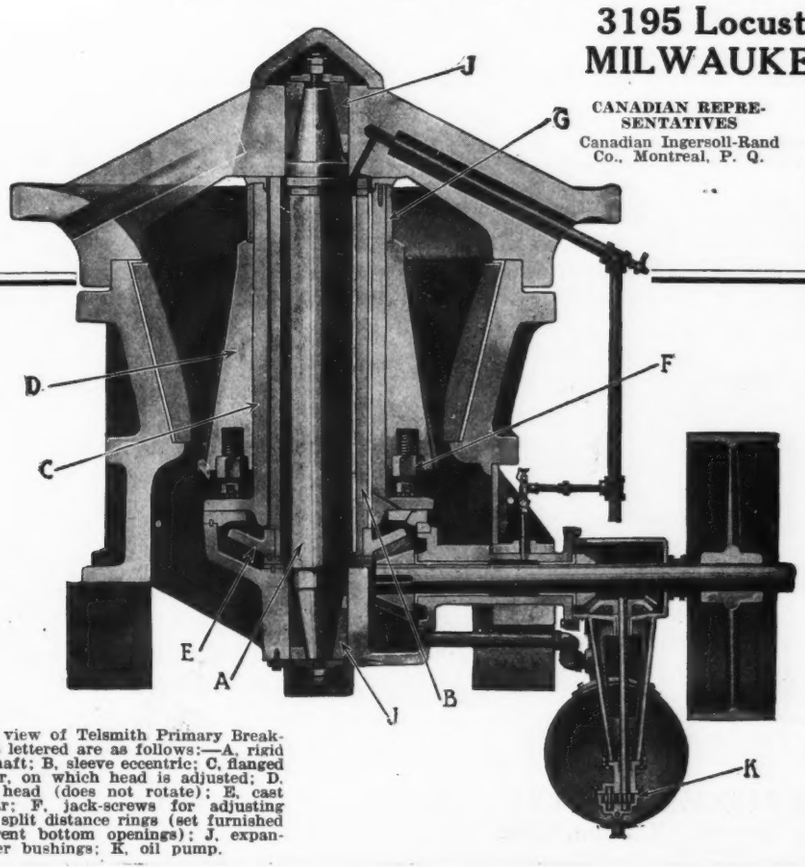
Contrast with a lever-shaft breaker, averaging only ¼ in. to ⅜ in. movement at the top of the head; and it is readily seen why Telsmith takes bigger rock and crushes more of it. It is the big chunks that require the long pinch to prevent slippage, rocketing and bridging. Telsmith supplies this long pinch exactly where and when it is needed. Is it surprising, then, that Telsmith saves labor in block-holing, sledging and feeding or that Telsmith feeds and discharges more rapidly?

Glad to send our Catalog No. 168 (Telsmith Primary Breakers) and Bulletin No. 2FI (Telsmith Reduction Crushers).

## SMITH ENGINEERING WORKS

**3195 Locust Street**
**MILWAUKEE, WIS.**

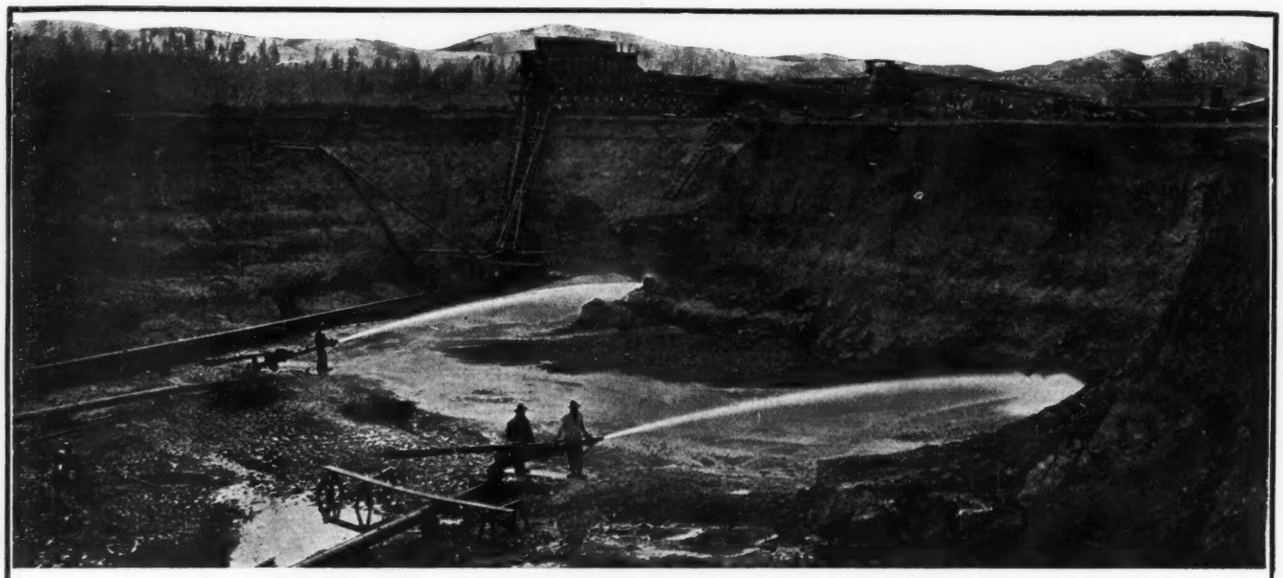
**CANADIAN REPRESENTATIVES**
Canadian Ingersoll-Rand Co., Montreal, P. Q.




Sectional view of Telsmith Primary Breaker. Parts lettered are as follows:—A, rigid central shaft; B, sleeve eccentric; C, flanged head liner, on which head is adjusted; D, crushing head (does not rotate); E, cast steel gear; F, jack-screws for adjusting head; G, split distance rings (set furnished for different bottom openings); J, expansible taper bushings; K, oil pump.

**LOCAL OFFICES:**

Old Colony Bldg., Chicago, Ill.
50 Church St., New York City.
806 Otis Bldg., Philadelphia, Pa.
261 Franklin St. Boston, Mass.
110 W. Park Way, N. S. Pittsburgh, Pa.
6110 Euclid Ave., Cleveland, O.
2540 University Ave., St. Paul, Minn.
Franklin and Channing Aves., St. Louis, Mo.
528 Boston Bldg. Denver, Colo.
Salt Lake Hardware Co., Salt Lake City, Utah
625 Market St. San Francisco, Calif.
617 Hollingsworth Bldg. Los Angeles, Calif.



# HYDRAULIC MINE EQUIPMENT

**The Original Inventors and Manufacturers of This Class of Mining Machinery**

**WE DESIGN AND BUILD**

**Hydraulic Elevators and Water Lifters, Giants, Water and Reservoir Gates, Patented Riffles and Non-Erosive Steel Plates for Sluice Boxes, Riveted Steel Pipe, Hydraulically Operated Derricks, Pumps, Turbines and Water Wheels**

**To meet various conditions and for all purposes**

*Our experience covers more than 60 years*

**JOSHUA HENDY IRON WORKS, 75 Fremont Street, San Francisco, Cal., U. S. A.**

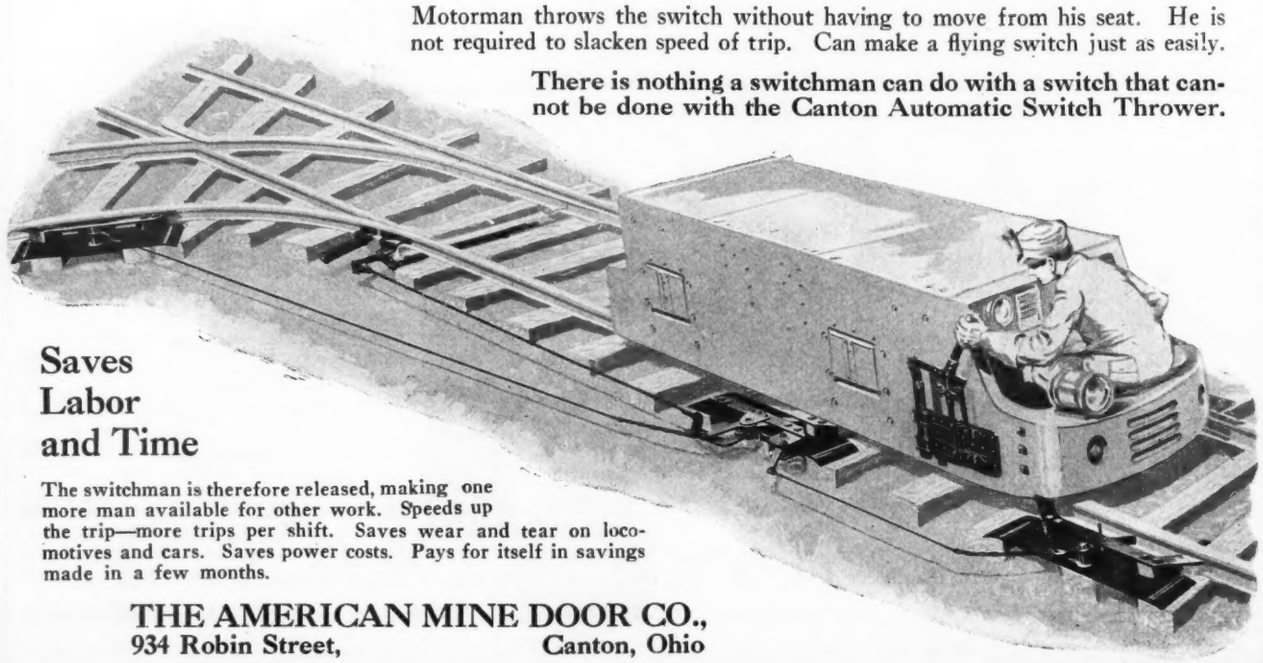
Safety Devices Beat Safety Rules

*Remove all possibility of accident to switchman by using the*

# Canton Automatic Switch Throwers

Motorman throws the switch without having to move from his seat. He is not required to slacken speed of trip. Can make a flying switch just as easily.

**There is nothing a switchman can do with a switch that cannot be done with the Canton Automatic Switch Thrower.**

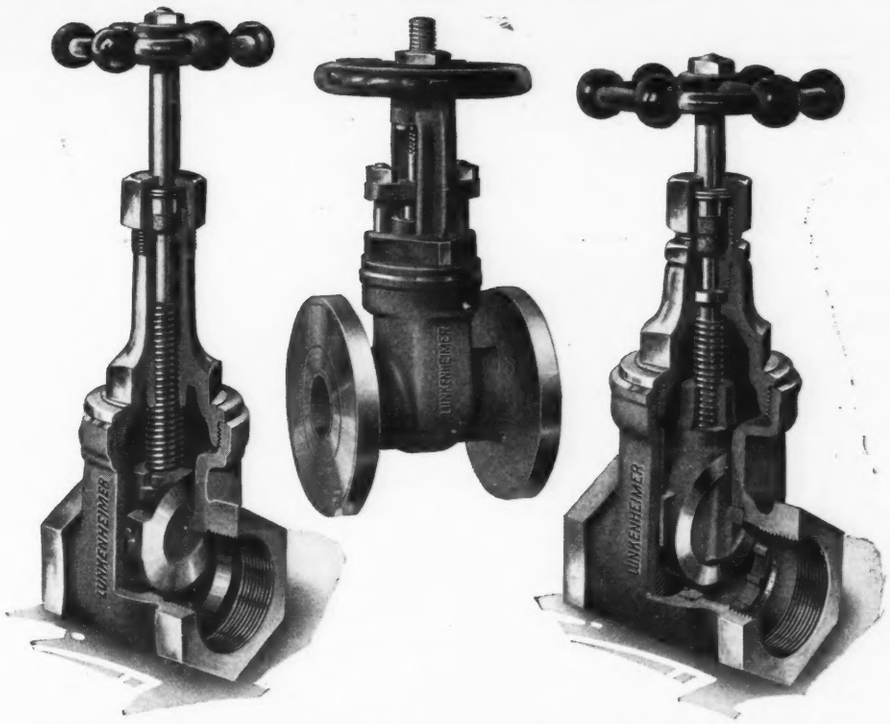


## Saves Labor and Time

The switchman is therefore released, making one more man available for other work. Speeds up the trip—more trips per shift. Saves wear and tear on locomotives and cars. Saves power costs. Pays for itself in savings made in a few months.

**THE AMERICAN MINE DOOR CO.,**
**934 Robin Street, Canton, Ohio**

# LUNKENHEIMER
## *Bronze Gate Valves*




**LUNKENHEIMER BRONZE GATE VALVES remain tight under extreme operating conditions because the design is correct, the material is the well known LUNKENHEIMER "Valve-Bronze" and they are made with the skill which characterizes all LUNKENHEIMER Products.**

**The "double taper wedge seat" construction embodied in LUNKENHEIMER Bronze Gate Valves has proved its practicability. In addition to tightness, it insures ease of operation, minimum wear and consequent long service life.**

**The DOUBLE DISC TYPE for pressures up to 150 pounds has a simple and practical ball and socket bearing between the discs which makes them self adjusting and eliminates the needless maintenance cost prevalent on valves employing a greater number of working parts.**

**The WEDGE DISC type has a single disc, with the seats finished in exact alignment with the disc faces, and the seatrings are renewable on sizes one inch and larger. Made with Inside Screw Stationary Stem, and with Outside Screw and Yoke Rising Stem for pressures up to 200 and 300 pounds.**

**LUNKENHEIMER BRONZE GATE VALVES are obtainable from LUNKENHEIMER Distributors situated in every commercial center. Insist on having the genuine.**

THE LUNKENHEIMER CO.
"QUALITY"
LARGEST MANUFACTURERS OF
HIGH GRADE ENGINEERING SPECIALTIES
IN THE WORLD
NEW YORK CHICAGO CINCINNATI BOSTON LONDON
EXPORT DEPT. 129-135 LAFAYETTE ST., NEW YORK

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CURRENT EDITION
OF CATALOG BEARS
№ 58
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LUNKENHEIMER
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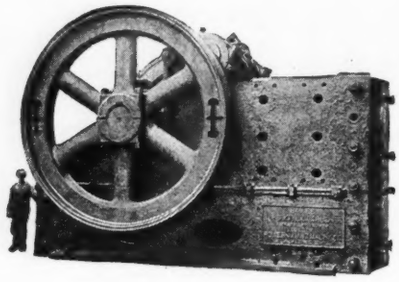
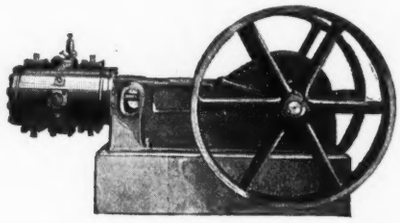
*Superior McCully Gyratory Crusher*



*Superior Jaw Crusher*



*Single Power Driven Air Compressor*

# Coal-oil Johnny

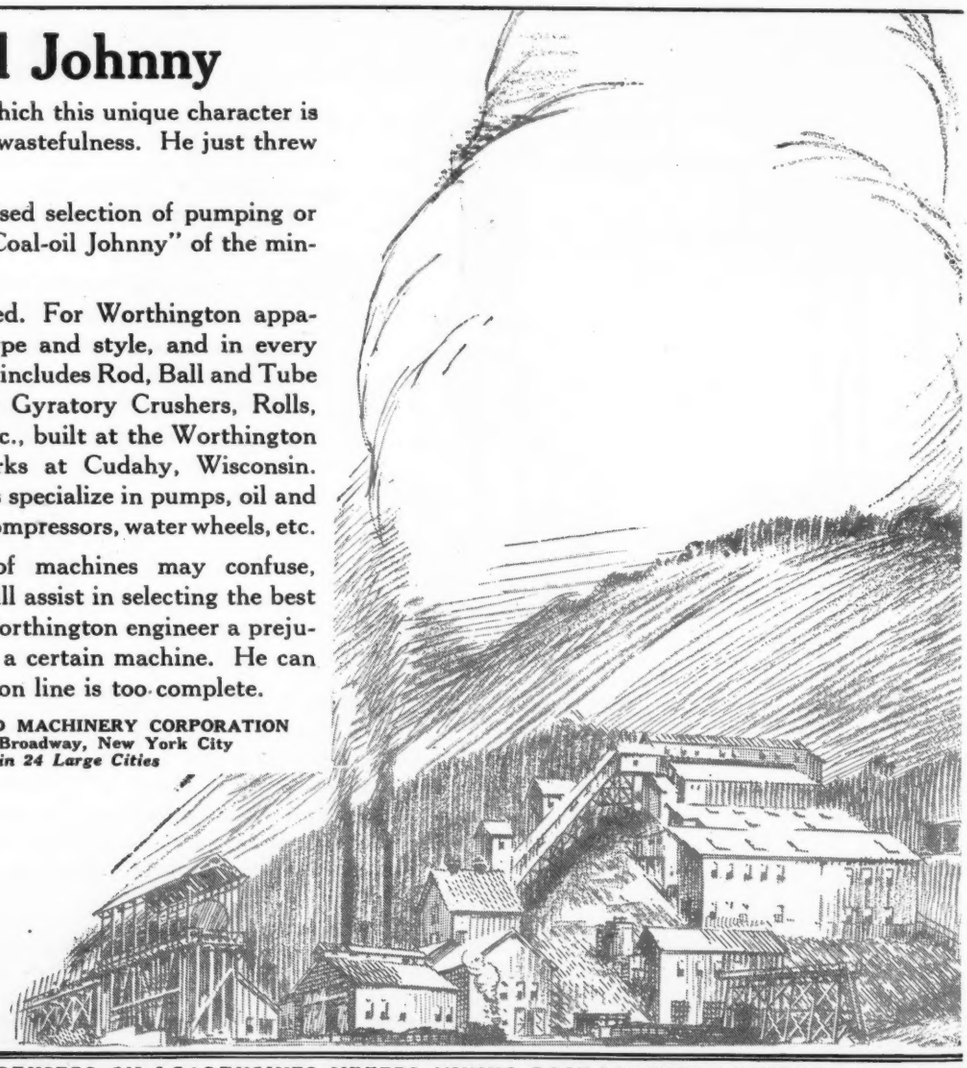
THE chief thing for which this unique character is remembered was his wastefulness. He just threw his money away.

Carelessly or poorly advised selection of pumping or other machinery is the "Coal-oil Johnny" of the mining industry today.

And it's so easily remedied. For Worthington apparatus is built in every type and style, and in every capacity. The machinery includes Rod, Ball and Tube Mills, Superior McCully Gyratory Crushers, Rolls, Conveying Machinery, etc., built at the Worthington Power and Mining Works at Cudahy, Wisconsin. Other Worthington works specialize in pumps, oil and gas engines, condensers, compressors, water wheels, etc.

Where a wide choice of machines may confuse, Worthington engineers will assist in selecting the best type. In no case has a Worthington engineer a prejudice either for or against a certain machine. He can not have—the Worthington line is too complete.

**WORTHINGTON PUMP AND MACHINERY CORPORATION**
***Executive Offices:* 115 Broadway, New York City**
***Branch Offices in 24 Large Cities***



E-31

**PUMPS—COMPRESSORS—CONDENSERS—OIL & GAS ENGINES—METERS—MINING—ROCK CRUSHING & CEMENT MACHINERY**

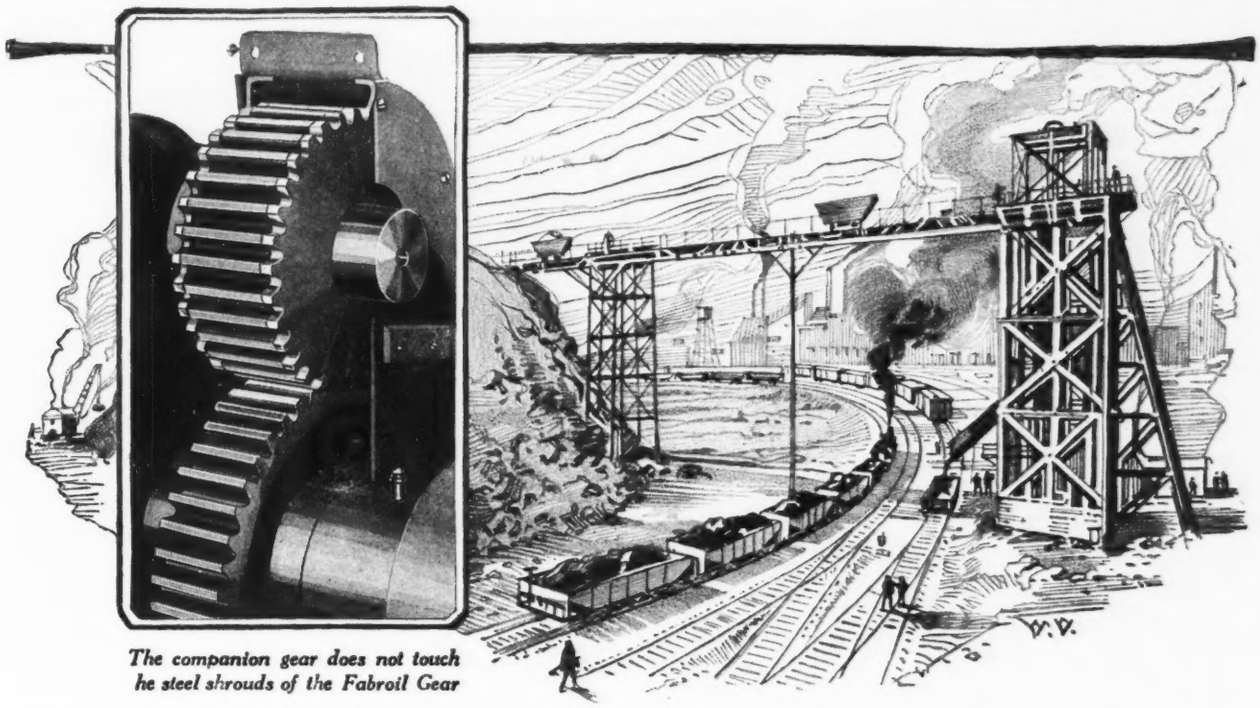
# WORTHINGTON

**Deane Works, *Holyoke, Mass.***
**Blake & Knowles Works**
***East Cambridge, Mass.***
**Worthington Works**
***Harrison, N. J.***
**Laidlaw Works, *Cincinnati, Ohio.***

**Hazleton Works, *Hazleton, Pa.***

**Gas Engine Works, *Cudahy, Wis.***
**Power & Mining Works**
***Cudahy, Wis.***
**Snow-Holly Works**
***Buffalo, N. Y.***
**Epping-Carpenter, *Pittsburgh, Pa.***

*Gears that give good service regardless of where they operate are the sort that the mining industry can use in large quantities*



*The companion gear does not touch he steel shrouds of the Fabroil Gear*

## Underground or "on top" Fabroil Gears are good

Deep in the wet, rat-infested workings of a mine or in the dry clean power plant at the top, Fabroil Gears work equally well. They serve on motor-driven pumps, hoists, machine tools and similar machinery.

In high speed gear trains running 700 feet or more per minute at pitch line, these compressed cotton gears give entire satisfaction. In hot oil baths or in a constant oil splash they perform up to standard. No matter how adverse the conditions may be these tough resilient gears relieve machinery of much vibration and so assure to it longer life.

For a wide range of uses Fabroil Gears are made in any sizes from one inch diameter upward. In mining operations they are commonly used in sizes from 3 to 12 inches.

***Ask the nearest G-E office for complete information***

**General Electric Company**

General Office Schenectady, N.Y.

Sales Offices in all large cities

40-168

ENGINEERING & MINING JOURNAL

# Think "SEARCHLIGHT" First

## ADVERTISING RATES

**POSITIONS VACANT**—Business Opportunities and other undisplayed ads, 8 cents a word, minimum $2.00 an insertion.

**POSITIONS WANTED**—Evening work wanted, tutoring and other undisplayed ads of individuals looking for employment, 4 cents a word, minimum 75 cents, payable in advance.

**ADD 5 WORDS** for box number in undisplayed ads if replies are to any of our offices. There is no extra charge for forwarding replies.

**DISCOUNT OF 10%** if one payment is made in advance for 4 consecutive insertions of undisplayed ad.

**ADS IN DISPLAY TYPE**—Space is sold by the inch (30 in. to a page), the price depending upon total space used within a year, some space to be used each issue.

**RATE PER INCH** for ads in display space:

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|---|---|
| 1 to 3 in., $4.50 an in. | 15 to 29 in., $3.90 an in. |
| 4 to 7 in., $4.30 an in. | 30 to 49 in., $3.80 an in. |
| 8 to 14 in., $4.10 an in. | 50 to 99 in., $3.70 an in. |

# POSITIONS VACANT — EMPLOYMENT — POSITIONS WANTED

## EMPLOYMENT AGENCIES

EXECUTIVES seeking superior positions find our confidential service extremely satisfactory. Let our Mr. H. H. Harrison confidentially negotiate for you suitable positions with proper employers, as he has successfully done for thousands of others since 1909. Inquiries invited. (Not an agency.) The National Business Bourse, Confidential Negotiators, Association Building, Chicago.

## EMPLOYMENT SERVICE

EXECUTIVES qualified for salaries of $2,500 to $25,000 and upward are invited to communicate in strict confidence with the undersigned, who will conduct preliminary negotiations for such positions. The procedure used is peculiar to this service, differing essentially from all others, and is constructive and initiative, applied individually and in no way jeopardizing present connections. Established 1910. Send name and address only for particulars. R. W. Bixby, Inc., 308 Lockwood Building, Buffalo, N. Y.

## POSITIONS WANTED

ASSAYER and metallurgical chemist, experienced gold and silver mines. Speaks Spanish. Knows cyaniding of gold and silver ores. Age 24, single. Southwest, Central or South America preferred. Available June 10. Best of credentials. PW-212, Eng. & Mining Journal, Old Colony Bldg., Chicago.

MANAGER of mines and examining engineer, technical graduate with 25 years' experience in United States, Canada and Alaska, in exploration, development and operation. PW-225, Eng. & Min. Journ., Rialto Bldg., San Francisco.

METALLURGIST open for engagement after July; technical education; 20 years' practical experience in mining and metallurgical work. U. S., Mexican and South American experience. Specialty, cyanidation and improvement of metallurgical practice. Latin-American countries preferred. $5,000 per year. PW-207, Eng & Mining Journal, Old Colony Bldg., Chicago.

METALLURGIST — Specialist in smelting and refining lead and copper ores and bullions, and recovery platinum metals. Experienced in operating coal dust fired furnaces and manufacture copper sulphate. PW-217, Eng. & Min. Journ.

MEXICO—Superintendent or manager, age 40, married, technical graduate; 17 years' general mining experience development, operation and construction; 10 years with present company in Mexico. PW-222, Eng. & Min. Journ., Old Colony Bldg., Chicago.

### In Replying to "Blind" Ads

be careful to put on envelope the key number in the ad and also local address of office to which reply is sent.

10th Ave. at 36th St., New York.
935 Real Estate Trust Bldg., Phila.
533 Leader-News Bldg., Cleveland.
1570 Old Colony Bldg., Chicago.
531 Rialto Bldg., San Francisco.

### Important

Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents — send copies.

0195

## POSITIONS WANTED

MINING engineer, technical graduate, eight years' metal mining experience, from mucker to chief engineer and assistant mine superintendent, desires position as superintendent, foreman or mine engineer; capable executive; age 32. Speaks Spanish. Latin American experience. Will go anywhere with good company. PW-214, Eng. & Mining Journal, Leader-News Bldg., Cleveland.

MINING engineer, specialist in difficult ore dressing problems desires position. Good on investigations, reports, etc. Best of references. Will go anywhere. Fluent Spanish. PW-226, Eng. & Min. Journ., Rialto Bldg., San Francisco.

OPEN for engagement, competent mining man, technical education, age 32, married; very familiar with large scale gold mining operations, shrinkage, stoping, tunneling, development work and examination. PW-223, Eng. & Min. Journ., Real Estate Trust Bldg., Phila.

SUPERINTENDENT or engineer, technical graduate; 10 years' successful experience in mining, milling and examination. Speaks Spanish; available on 30 days' notice. At present in Mexico. PW-215, Eng. & Min. Journ., Old Colony Bldg., Chicago.

## SALESMAN AVAILABLE

ENGINEER salesman desires position where long and varied foreign and domestic experience can be utilized by an exporting firm to build up overseas trade; familiar with heavy machinery, mining, milling and allied industry supplies. AS-227, Eng. & Min. Journ., Rialto Bldg., San Francisco.

## BUSINESS OPPORTUNITIES

**Coal Economy Service**

Firms dealing directly with coal consumers, no matter where located, can add our "Service" to their line with profit. It also acts as a feeder to their own line. Any capable man with some knowledge of heating can make money with it; 25% increase in heat from coal or 25% saving of coal guaranteed. Endorsed by Tax Payers Associations and leading apartment house owners in New York City and elsewhere. BO-224, Eng. & Min. Journ.

You can get

### A Production Checker

**at little cost**

Here is an opportunity to get a *Productograph* to keep count and make curve chart record on one to twenty producing machines. From these records you know exactly the production you are actually getting from your machines. No guessing. It is in first class condition and various spare parts are included.

**Bargain price for quick sale.**

W. A. Hefner, care of McGraw-Hill Co., 10th Ave. at 36th St., New York City

**JOHN BOYLE, JR.**

### PATENTS

**Ouray Building, Washington, D. C.**

16 years on the Examining Corps of the U. S. Patent Office

**I will purchase choice mineral specimens crystallized and showy ones. Crystallized gold specimens desired and will pay good premium on same. I sell at $28.50 delivered MINERAL COLLECTION 115 specimens containing every important mineral specie. Pamphlet supplied.**

**G. S. SCOTT**
**20 Nassau St., New York**

FOR SALE

### SILVER MINING PROPERTY

In Austin, Nevada, consisting of approximately 1200 acres, one-half of which are patented. Last owned by Austin-Manhattan Consolidated Mining Co. Includes old mines of the MANHATTAN MINING CO., with record production of over TWENTY MILLION DOLLARS. None of the old mines are deep.

**WM. A. MARSHALL**
Resident Agent, Austin, Nevada

*Get* YOUR *wants into the* SEARCHLIGHT

0084

## WANTED

**Used Carbon (Black Diamonds) and Borts** And fragments wanted: Will pay highest prices. D. Dessau, Printing Crafts Bldg., 33d to 34th Sts. and 8th Ave., New York City.

## FOR SALE

**Feldspar Property For Sale**

About one hundred acres situated in eastern Ontario. Considerable development work has been done; government assay shows spar of good quality. This property can be economically worked and is convenient to railroad. For further particulars apply John Grigor, 420 Manning Ave., Toronto, Ontario.

**Property For Sale**

One car of diaphragm sheet and punch mica. Also a fine mine. Brown & Freeman, Thomaston, Ga.

## MISCELLANEOUS

**To Ore Buyers—U. S. and Foreign**

Want to hear from American and foreign radium and vanadium ore buyers. Address owners, Hart & Tomlinson, Gateway, Colorado, Mesa County.

**New Rails—Relayers**
**Cars, Locomotives, Steel Products**
Send us your inquiries
MERCHANTS STEEL & SUPPLY CO.
208 S. La Salle St., Chicago, Ill.

**GET OUR PRICES ON**
***NEW* AND *USED* TANKS**
Steel—wood—enameled
Rectangular—cylindrical
For gasoline—oil—tar—acid—air
Tanks and towers
Kettles—jacketed tanks—coils—etc.
Everything in TANKS
The Curtiss-Willis Co., 30 Church St., N. Y.

FOR SALE
**GYRATORY CRUSHERS**
from No. 18 down to No. 2. Jaw Crushers 84 x 108 down to 7 x 10. Pulverizers all types. Dryers, Screens, Elevators, Steam Shovels, Locomotives, Cars, Rails.
J. F. DONAHOO CO.
Birmingham, Ala.

**"Opportunity" Advertising:**
Think *"SEARCHLIGHT"* First!
0100

**MACHINERY**

**AIR COMPRESSORS**
1—450 ft. Cap., Ingersoll 2 stage, belt driven Air Compressor, 100 lb. pressure.
1—1800 ft. Cap., Class W. B. 2, Sullivan Steam Driven Air Compressor, 100 lb. pressure.
2—Single Tandem Fuel Oil Driven Compressors, Chgo. Pneumatic Tool Co., No. S. O. 2.

**CENTRIFUGAL PUMPS**
1—6-in. Swaby Horizontal Centrifugal Pump.
1—8-in. Fairbanks-Morse Horizontal Centrifugal Pump.
1—10-in. Fulton Horizontal Centrifugal Pump.
1—12-in. Worthington Horizontal Centrifugal Pump.
1—24-in. Kingsford Horizontal Centrifugal Pump.
2—4-in. Young Horizontal Centrifugal Pumps.

**CORRUGATED STEEL SHEETS**
500—Squares 2-gauge, 5 in. corrugations, O. H. Curved Steel Sheets (four forming a circle).
100—Squares 12-gauge, 5 in. corrugations, O. H. Flat Steel Sheets.
3000—Squares, 22-gauge, 2½ in. corrugations. Width 27½ in. length 7 ft. and 10 ft.

**VENTILATING BLOWERS AND PIPE**
American Blower Co. (Sirroco Type), 5 ft. 2 in. x 7 ft. 4 in., upper casing 4 ft. x 8 ft. Double Inlet 38 in., Upper Cone-shaped quadruple Outlet 36 in. Capacity 25,000 cu. ft. per min. (12).
10,000 ft. 30 in. dia., 18 gauge new Ventilating pipe.
10,000 ft. 18 in. dia., 18 gauge new Ventilating pipe.

**DUMP CARS**
150—12-yd. Western & Oliver all-steel, two-way Dump Cars. Standard gauge.
50—1¾-yd., 20-in. gauge, wood body, two-way Dump Cars.
8—36-in. gauge, 8-wheel Flat Cars, 40,000 lb. cap., 7-ft. wide, 20-ft. long, wheels 24-in. diam.

***Write for Industrial Bulletin No. 204***

**HARRIS BROTHERS COMPANY**
35th and Iron Sts., Chicago, Ill.

# MACHINERY FOR SALE

**AUTOCLAVES**—One 120-gal. steel with stirrer; one 220-gal. lead lined; one 100-gal. high pressure.
**CENTRIFUGALS**—60, 45, 42 and 32-in. iron basket; 48, 40, 36, 32, 30 and 26-in. copper basket.
**COOKERS**—24½ x 7½ ft., 5 x 16 ft. and 3 x 16 ft. with stirrer and steam jacket.
**CRYSTALLIZERS**—One Buffalo, 300-gal. crystallizer.
**DRYERS—Direct-heat Rotary Dryers**, 3 x 25 ft., 3½ x 25 ft., 4 x 30 ft., 5 x 35 ft., 5½ x 50 ft., 5½ x 60 ft., 6 x 50 ft. and 7 x 50 ft.; double shell Dryers, 4 x 20 ft., 5 x 30 ft. and 6 x 35 ft.
**Drum Dryers**, 40x 48 in., 5 x 12 ft. and 3 x 10 ft.
**Steam-Heated Air Rotary Dryers**, 4 x 30 ft., 6 x 30 ft.
**Steam Jacketed Dryers**, 5 x 15 ft., 4 x 7 ft., 3 x 16 ft. and 2½ x 10 ft. with stirrer.
**Rotary Vacuum Dryers**, 4x 10 ft., 5x30ft. and 5 x 33ft.
**Vacuum Shelf Dryers**, 20 shelf and 17 shelf.
**EVAPORATORS**—One quadruple effect with copper tubes; one double effect and one triple effect, all copper. One double effect, all iron, one double effect, copper tubes.
**FILTER PRESSES**—No. 850 Kelly, Nos. 20, 9 and 5 Sweetlands; 3 x 2 ft. and 11½ x 20 ft. Oliver; two 6 x 5 ft. and four 6 x 3 ft. Industrial rotary Filters; one 4 x 4 ft. Industrial dewaterer, plate and frame presses of wood and iron.
**HYDRAULIC PRESSES**—600, 350, 200, 100 and 65-ton hydraulic Presses; one Anderson Expeller.
**KETTLES**—400-gal. Fusion Kettles, 50-gal. Jacketed Kettles, 300, 400 and 500-gal. Dopp Kettles.
**KILNS**—Rotary Kilns, 8 x 60 ft., 6 x 60 ft., 5 x 55 ft., 5 x 20 ft., 3½ x 25 ft. and 3 x 25 ft.
**MILLS**—20-in. Schutz-O'Neill; No. 18 American ring roll pulverizer; 24-in Coggswell Mill; No. 000 and No. 00 Raymond Mills; 3-roll Raymond Mill, 8 x 8 ft., 6 x 5 ft., 3 x 3½ ft. and 2 x 3 ft. pebble mills; 6 x 8 ft., 5 x 3½ ft. 5 x 4 ft., 4½ x 3½ ft. and 2½ x 2¾ ft. Ball Mills; 3 ft. and two 8 ft. Marcy Mills; 42, 33 and 24-in. Fuller-Lehigh Mills; 4½ x 20 ft., 5 x 11 ft., 5 x 22 ft. and 6 x 20-ft. Tube Mills; 20 x 13 in., 30 x 16-in. 10 x 16-in., 9 x 12-in., 7½ x 13 in. and 7 x 10-in. jaw Crushers; one "Infant," one No. 0, one No. 2, two No. 3 and one No. 8 Williams' swing hammer Mills; one Kent type "G" Mill, two 36 in., and one 40-in. cage mills; two 4½-ft. and two 3-ft. Hardinge conical Mills; 18 x 12 in., 20 x 12 in. and 30 x 10 in. Roll Crushers; No. 0, 1 and 3 Sturtevant rotary Crushers; one No. 3 Telsmith Breaker; one 36-in. Sturtevant Emery Mill; one Griffin Mill; one 51 x 14-in. Chaser Mill; No. 1 Sturtevant ring Roll Crusher; No. 2 Mead Mill; one 24-in. "Monarch" Burr Mill.
**MIXERS**—One 1-ton acid phosphate Mixer; one 1-ton batch Mixer; ½-ton batch Mixer; ten 100-gal. W. & P. heavy duty jacketed Mixers; 150 and 60 gal. dough Mixers.
**NITRATORS**—1600 gal., 700 gal., 600 gal. and 350 gal.
**RETORTS**—Six Buflokast 3100-gal. Nitric Acid Retorts, 1500 gal. Acetic Acid Retort.
**STILLS**—Copper Stills and Iron Stills, with dephlegmators, condensers and fractionating columns; 16 to 60 in. in diameter for solvent recovery or alcohol or ether manufacturing; 500-gal. and 2000-gal. C. I. Stills with stirrers, 8 x 3-ft. beta naphthol Stills; 50-gal. copper Stills; 2000-gal. copper vacuum pan, eight 300-gal. steel jacketed stills.
**SPECIALS**—One Complete Toluol Plant. One McDougal and one Wedge Mechanical Furnaces; five Automatic Package Weighing Machines; Electric Arc Furnaces; Jigs; one drag line Excavator; 6 x 8 ft., 6 x 5 ft. and 6 x 3 ft. Newaygo Vibrating Screens; one Leschen aerial Tramway; automatic Cement Scales.
**VACUUM PUMPS, DRY**—8 x 16 x 12 in., 12 x 22 x 18; 12 x 12 in.; 6 x 6 in. 5 x 4 in. **WET**—10 x 16 x 12 in., 10 x 14 x 18 in. **WITH JET CONDENSERS**—10 x 14 x 12 in., 8 x 14 x 12 in., 6 x 8 x 10 in.

***All this equipment is complete and in good condition.***

**W. P. HEINEKEN, *Engineer*, 95 Liberty St., New York City** Telephone Cortlandt 1841

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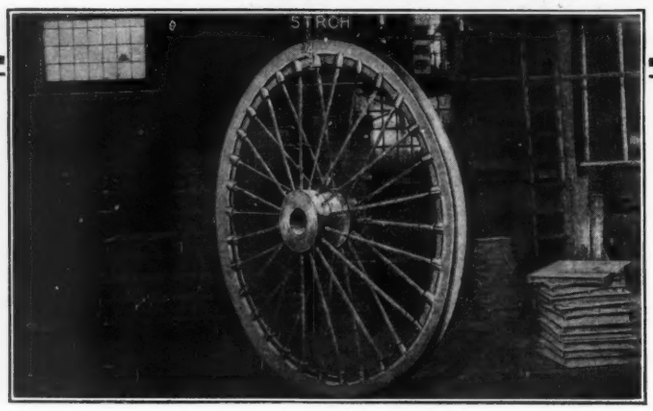
is read by men whose success depends upon thorough knowledge of means to an end—whether it be the securing of a good second-hand piece of apparatus at a moderate price, or an expert employee.

## THE BEST PROOF

of this is the variety of this journal's Searchlight ads. Without a constant and appreciable *demand* for such machinery or services, by its readers, the market place which these advertisements represent could not exist for any length of time.

Are *you* using the Searchlight Section?

0318




# *You're Ordering too many Sheave Wheels*

No complaint? They seem to last considerable time?

Well, note this:—when your sheaves are gone, discarded, worn out, Stroh Sheaves ***would still be good.***

Stroh Sheaves have an established performance record of at least nine times greater life than ordinary sheaves.

Knowing that, can you afford to discard sheaves so often?

Remember the life of a sheave is in the tread, and this represents but 2% of the total wheel.

Sheaves made by the Stroh Process are integral castings, with spokes, hub, etc., of the usual material but a tread of Stroh Alloy. And it's this tough, close grained alloy which gives the long life to Stroh Sheaves, reduces rope wear and shutdown charges materially.

We have many Stroh treated products. Data sent on request.

**STROH STEEL-HARDENING PROCESS CO.**

Attention Mining Department

804 Westinghouse Building, Pittsburgh, Pa.

*Western Representative*

Hickok & Hickok

221 Kearns Bldg., Salt Lake City, Utah. 507 Hobart Bldg., San Francisco, Cal. 301 Henry Bldg., Portland, Ore.



...t is reinforced by ¼-in. rods and by a No. 8 wire-screen of triangular mesh. Spikes are driven into the sides of the bin and the reinforcement is hung from these spikes. The spikes, of course, also help to reinforce. Since the bins were lined with gunite, no more trouble has been experienced from the hot 'roast' setting fire to the wood. The bins are also fire-proofed on the outside by a layer of gunite about ¼ or ½ in. thick reinforced with chicken-wire. This serves to preserve the wood from decay.

*(Mining and Scientific Press, Jan. 8, 1921.)*

## "The Bins at the Sampling-Mill Used for the First Roast or Pre-Roast Material Are Lined With 'Gunite'"

Since they were lined with Gunite there have been no more fires. For Gunite, the sand-cement product of the "Cement-Gun," is fireproof.

You need the "Cement-Gun" at your mine. The money it will save you in repairs above and below ground will surprise you.

Ask your neighbor—or write us.

***The "Cement-Gun" is not a restricted article. It may be purchased outright from us and used by anyone.***

**CEMENT-GUN CO., Inc.**

**Incorporated**

**Cornwells Heights, Bucks Co., Pa.**

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IN ITS struggle for existence the gold and silver mining industry needs the help of every possible saving and economy. Aero Brand cyanide has always been and is still being sold at the lowest delivered prices for actual 100 per cent sodium cyanide.

The efficiency of extraction with Aero Brand cyanide has been verified by competent engineers throughout the American continent under the greatest variety of conditions, with uniformly successful results, for a period of more than four years.

The ease of handling this flaky product and its accelerating effect on settling and filtration are additional aids to economy.

All quotations are based upon the pound of 100 *per cent* sodium cyanide (132.85 per cent potassium cyanide).

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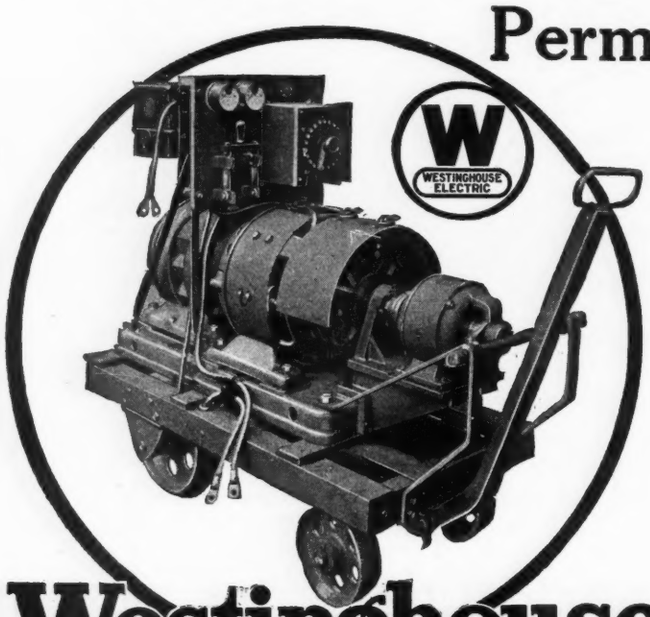
# Keep Your Tonnage High with Quick, Permanent Repair Work




Every breakdown on your property means less available equipment and less tonnage. Don't scrap the broken equipment or send it away to be repaired — ***weld it*** — right on the property and get it back in service in hours instead of days.

The Westinghouse portable arc welder shown on the left, in the hands of an operator can save you thousands of dollars—by welding broken cars—car wheels — gears — shafts — pipe lines, and hundreds of other metal parts. Welding is the ***permanent*** economical repair process.

*Write for Bulletin* 7149 *today.*

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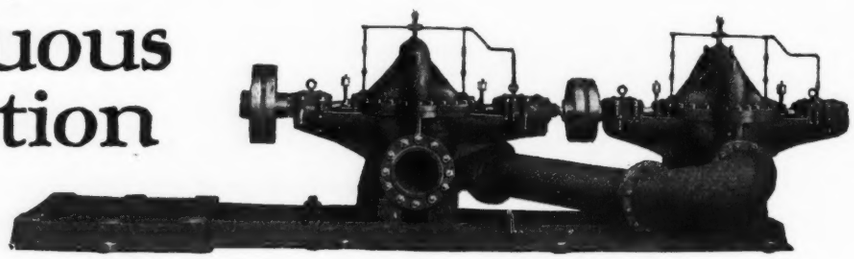
# Continuous Production



Continuous production of the mine is contingent largely on the dependability of its pumping system. A faulty unwatering plant not only seriously interrupts production, but may cause untold damage resulting from flooding.

Byron Jackson pumps have played a predominating part in the unwatering of mines through demonstrated dependability and economy of operation extending over a long period of years.

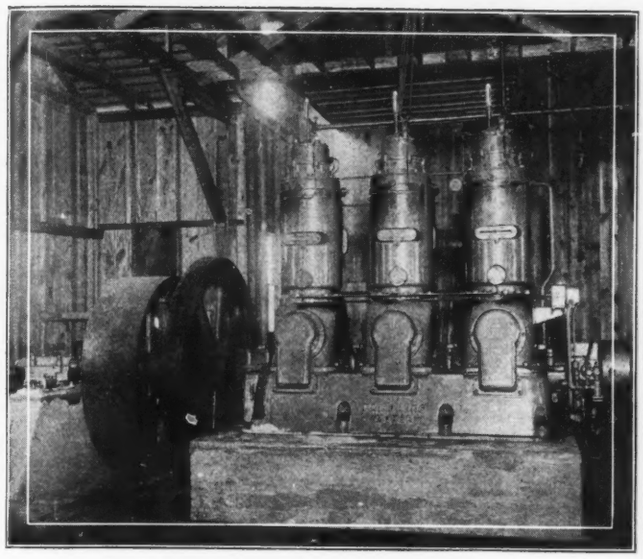
A Byron Jackson pumping unit is assurance of continuous production.

## BYRON JACKSON IRON WORKS-INC

*Wherever water is to be lifted*

**411 Sharon Building - SAN FRANCISCO**

# *Fairbanks-Morse "Y" Oil Engines*



## Four "Y" Engines—Total 302½-hp. in this Oklahoma Lead Mine

This installation made in 1917, has, in the words of the mine superintendent, "given them the cheapest and most satisfactory power they have ever had experience with."

A 150-hp. operates a 16-in. crusher, 4 sets of 36-in. rolls, 4 elevators, 4 jigs, 2 screens and a 6-in. Centrifugal pump. A 100-hp. drives a 599 ft. Compressor. In the sludge department a 37½-hp. "Y" operates a set of 36-in. sand rolls, sludge tables, sand and tailing elevators, a 48 x 156-in. screen and a 3-in. Centrifugal Pump. A 15-hp. Horizontal "Y" drives a 12½-kw. generator for furnishing light. With fuel costing 6½c. per gallon, the cost of mill dirt averages 2½c. per ton.

"Y" Oil Engines, 10-hp. to 200-hp., uses low-priced fuel oils economically. They are simple in construction—easy to start—simple to operate—no licensed engineer required.

FAIRBANKS-MORSE QUALITY F M 100%

**Fairbanks, Morse & Co.**
MANUFACTURERS CHICAGO
*The Canadian Fairbanks-Morse Co., Ltd., Montreal*
Oil Engines - Pumps - Electric Motors and Generators - Fairbanks Scales - Railway Appliances - Farm Power Machines



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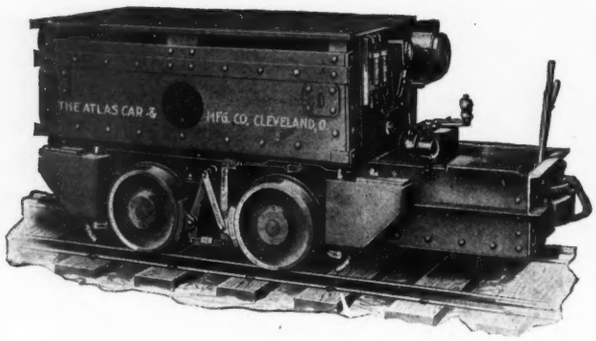


# Standard Type "C" LOCOMOTIVES

*are built especially for metal mine haulage*

THIS TYPE "C" Locomotive embodies all the essential features of other Atlas Storage Locomotive types — but is particularly well suited for metal mine haulage.

It is compact, efficient, and economical to operate. It has standardized parts. All parts are thoroughly protected, yet easily accessible. It has an improved type of controller, removable battery trays, Hyatt Roller Bearings and other mechanical features that make for dependability and long life.

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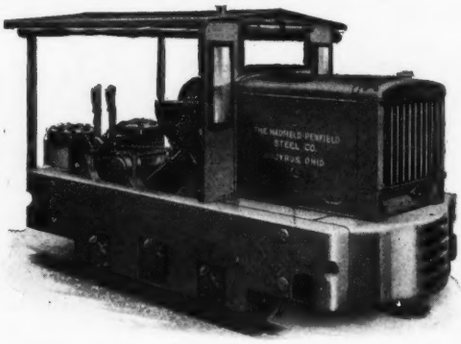

## *How Do You Figure Haulage Cost?*

If you work on the principle that last year it costs so much, add a certain percentage for depreciation to that figure and consider that this year's costs will be thus and so.

Might it not be advisable to discard your present haulage system and start over again on your figuring?

The American Gasoline Locomotive has shown a saving of 50% over other systems.

Isn't that of interest to you?

Figure some with that.

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*Reduce the cost of Lubrication*

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Superla Mine Car Greases are made specially for mine cars. Oily lubricants either feed too freely, running out of the bearings shortly after being applied, giving no service whatever, or they do not feed sufficiently, the difficulty not being detected until great damage to wheels and axles has taken place.

"Mine Car Lubrication" is the title of a booklet prepared by our Engineering Department. It describes the various types of mine car equipment in use and tells which lubricant is best adapted to the kind of equipment you use.

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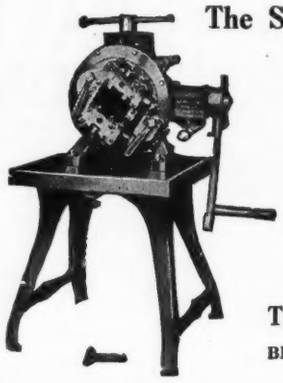

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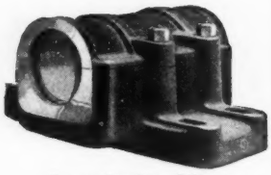

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are designed and built with one idea—that of satisfaction and service uppermost. We can supply any type of wood tank desired from our thoroughly equipped factory located in the heart of the Northwest's greatest timber belt. *National Tanks* are manufactured under the most rigid factory inspection. Every piece of material must be passed on by an expert. It is that kind of manufacturing conditions coupled with our years of experience that makes National Tanks *superior*.

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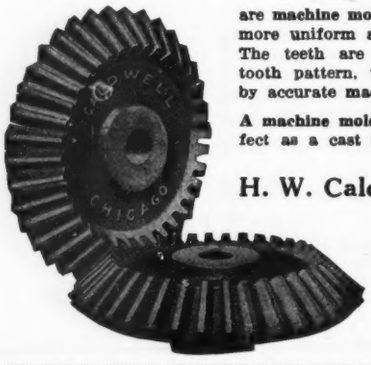

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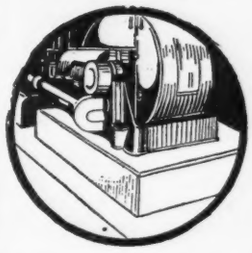

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A necessity for turbine protection, engine cylinder economy and utilization of superheat for all its benefits.

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## SHOVELING MACHINES

do the work of 15 to 20 men—load 200 to 300 tons per 8-hour shift—and save money. Myers-Whaley Machines are operating in all kinds of mines—stoping, tunneling and development—it's the modern method of mining. Write for details.

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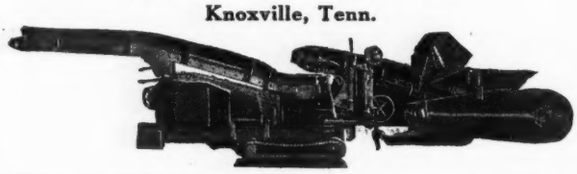

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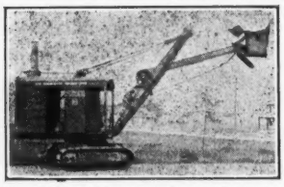

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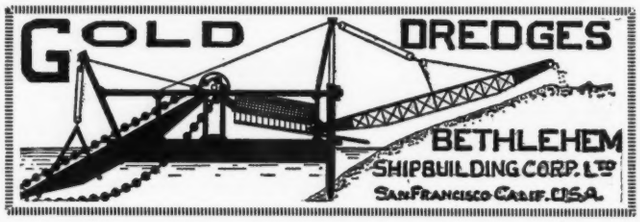


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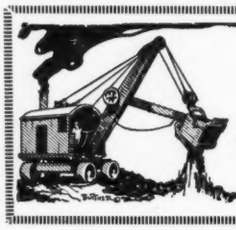

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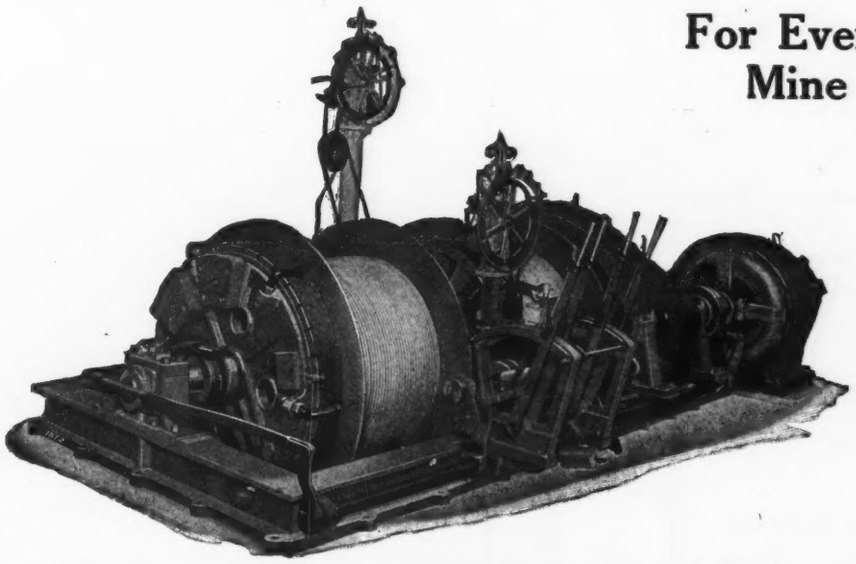

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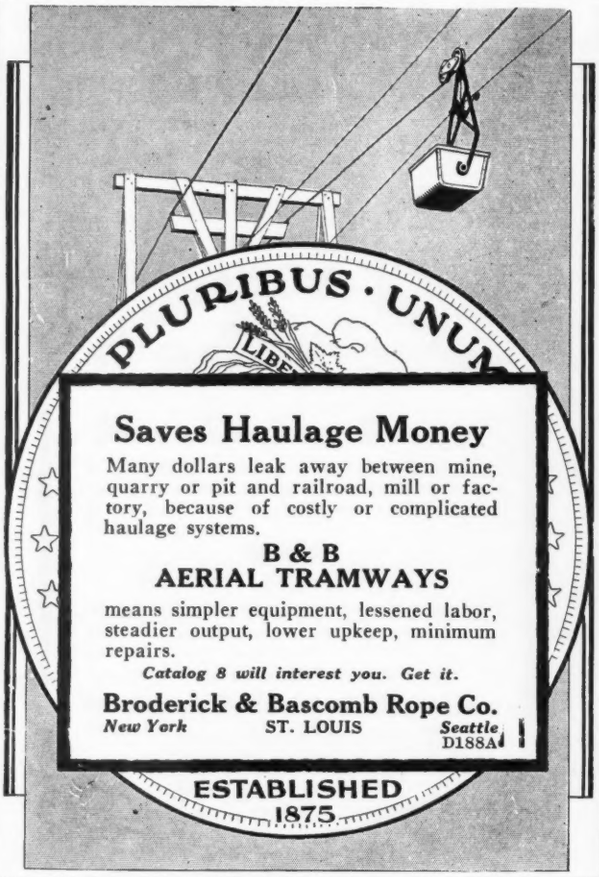


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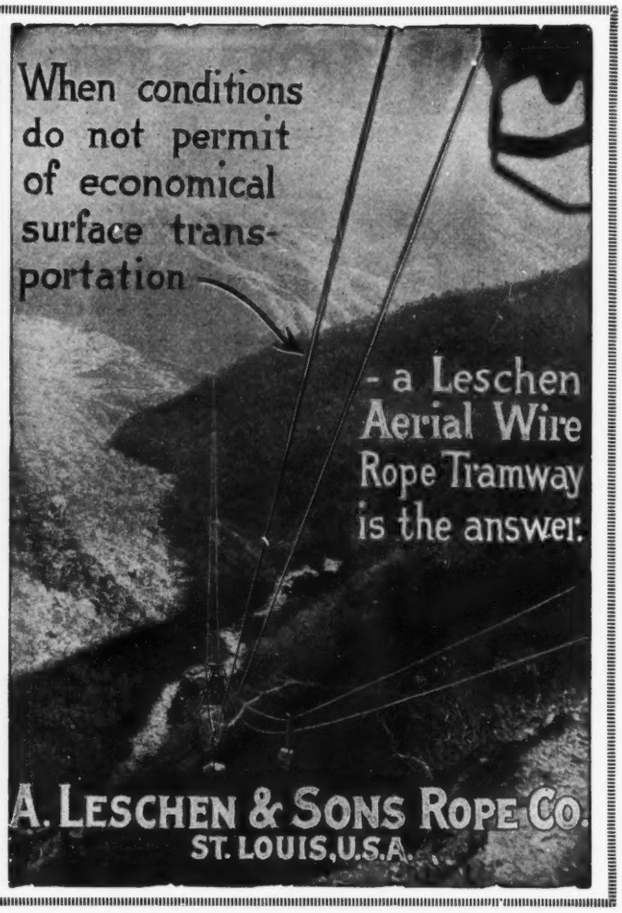
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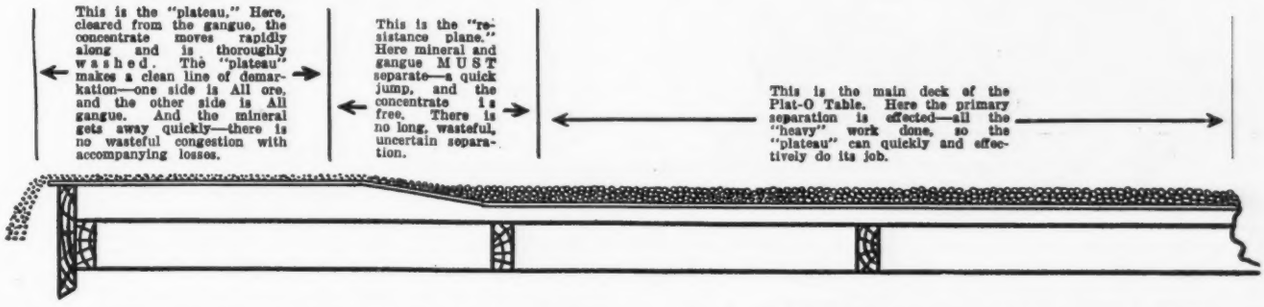
This is the "plateau." Here, cleared from the gangue, the concentrate moves rapidly along and is thoroughly washed. The "plateau" makes a clean line of demarkation—one side is All ore, and the other side is All gangue. And the mineral gets away quickly—there is no wasteful congestion with accompanying losses.
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The above sectional drawing of the "business end" of a Plat-O Table is meant especially to show the "resistance Plane" and the Plateau itself. These are patented, and are the factors which enable Plat-O Tables, size for size and conditions for condition, to handle more feed than any other table, and with less attention.

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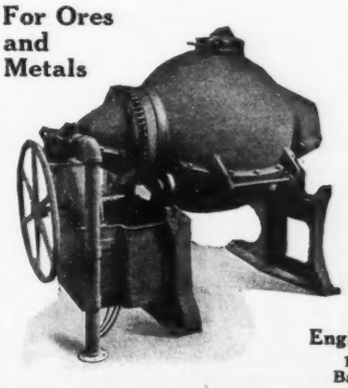

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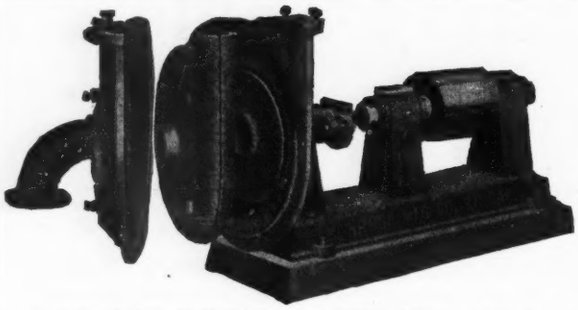

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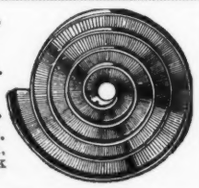

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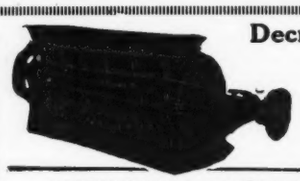

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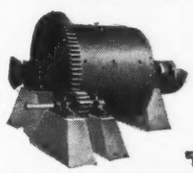

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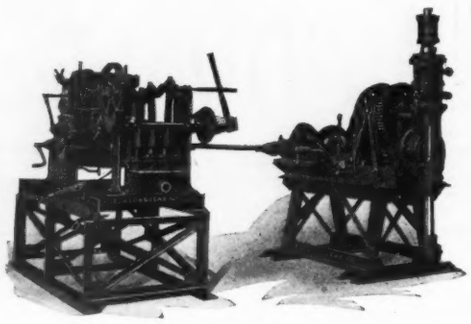

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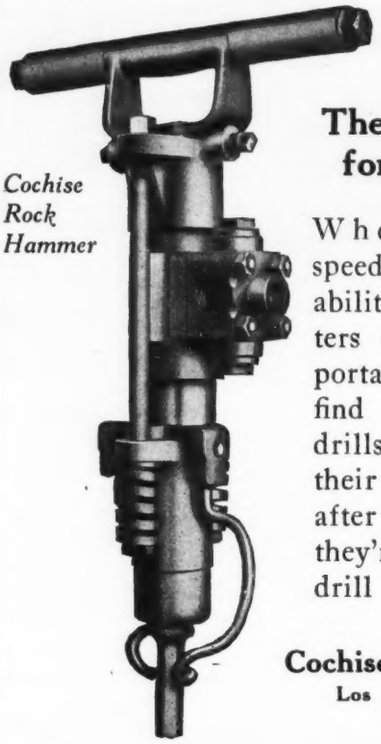

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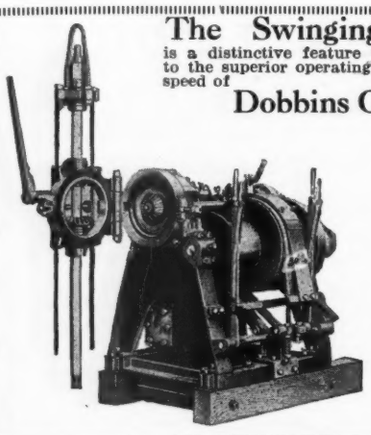

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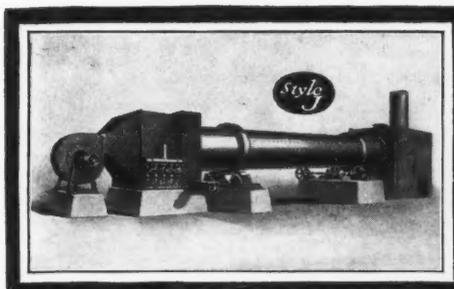


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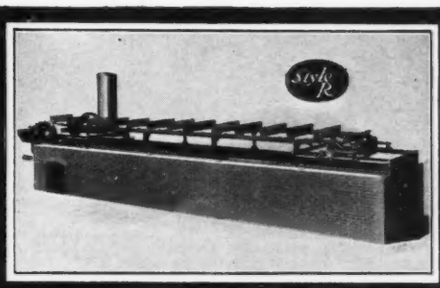


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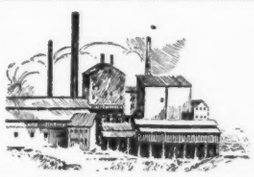

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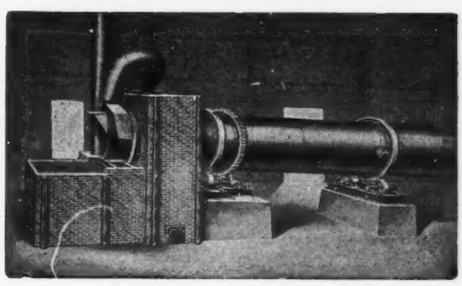

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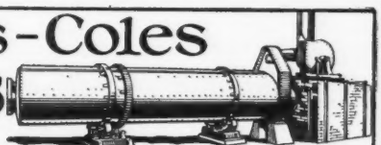

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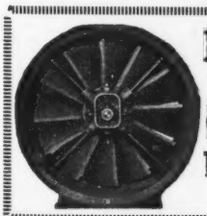

**BUCKEYE BLOWER COMPANY**

BUCKEYE MINE FANS-ALL SIZES

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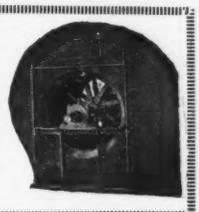

# Directory of Engineers

## ARRANGED GEOGRAPHICALLY

### UNITED STATES

**Alabama**

Hess, R. M.

**Arkansas**

Le Vasseur, Charles

**Arizona**

Botsford, C. W.
Burch, H. Kenyon
Burgess, John A.
Carpenter, M. M.
Clausen, Carl
Cole & Co.
Colvocoresses, Geo. M.
Dunning, Charles H.
Flagg, Arthur Leonard
Greenridge, S. M.
Halloran, Will
Mitke, Charles A.
McBride, Wilbert G.
McGregor, A. G.
Miller, Hugo W.
Mohave Assay and Engineering Office
Slak, John
Smith & Ziesemer
Spence, Harold C. E.
Stevens, T. N.
Tomlinson Engineering & Assay Office

**California**

Anderson, A. P.
Arnold, Ralph
Beaudette, A. J.
Bjorge, Guy N.
Burch, A.
Burns, William
Carpenter, A. B.
Carpenter, Jay A.
Clark, Baylies C.
Cranston, Robert E.
Dahl & Wartenweiler
Dennis, Clifford G.
Duncan & Lindley
Emlaw, H. S.
Evans, Burr
Farish, John B.
Fox, John M.
Gemmill, David B.
Grant, Wilbur H.
Hamilton, Beauchamp, Woolworth, Inc.
Hamilton, E. M.
Hamilton, W. R.
Hanks, Abbot A.
Hawxhurst, Robt., Jr.
Hershey, O. H.
Hodges, A. B. W.
Hoffman, Ross B.
Holland, L. F. S.
Hopkins, C. V.
Hutchinson, Randolph B.
Innes, Murray
Jenks, T. H.
Jones, C. C.
Jussen, Edmund
Kepner, R. B.
Kinzie, Robert A.
Lindberg, Carl O.
Locke, Augustus
McConnell, R. E.
MacBoyle, E.
Merrill, C. W.
Morris, F. L.
Mudd, S. W.
Myers, Dasaix B.
Osborn, Walter X.
Palmer, Wm. F.
Plate, H. Robinson
Probert, F. H.
Robertson, Jasper T.
Royer, Frank W.
Sansom, Frank W.
Short, Frank R.
Sill & Sill
Southwestern Eng'g Co.
Stebbins, Elwyn W.
Thurston, E. C.
Thomas, W. C.
Twining Laboratories, The
Wellman-Lewis Co.
Wilding, James
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**Colorado**

Beam, A. Mills
Bell, Charles N.
Burlingame, Walter E.
Chase, C. A.
Chase, Edwin E.
Chase, R. L.
Collins, George E.
Davis, Leverett
Draper, M. D.
Ermlich, Geo. J., & Co.
Fisher, C. A.
Frost, Oscar J.
Gahl, Rudolf
Garvin, C. J
Hills, V. G.
Kyle, T. D.
Marsh, Austin G.
McDaniel, A. K.
Nicholson, H. H.
Patton, Horace B.
Piers, W. L.
Radford, Walter J.
Rickard, Stephen
Ritter, E. A.
Roller, Arthur H.
Root & Simpson
Ward, William F.
Wilfley, Clifford R.
Wolf, Harry J.
Wood Ore Testing Co., The Henry E.
Zeigler, Victor

**Connecticut**

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Taggart, Arthur F.
Yerxa, R. B.

**Washington, D. C.**

Marshall, Stuart B.
Mulliken, H. S.
Putnam, Henry R.
Seward, John

**Florida**

Tanner, W. Lee

**Georgia**

Frame, James

**Idaho**

Burbidge, Frederick
Gaston, S. A.
Leonard Engineer's Co.
Pefley, W. W.
Smith, Gordon C.
Van Eman, A. G.
White, Rush J.

**Illinois**

Clapp, Rolla E.
Fuller, John T.
Hollis, H. L.
Hunt & Co., R. W.
Long, Frederic H.
Schwerin, Martin

**Indiana**

Indiana Laboratories Co., The

**Iowa**

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**Kentucky**

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Torbert, James B.

**Louisana**

Barton, L. A.

**Maryland**

Fulton, Chester A.
Holden, Edwin C.

**Massachusetts**

Brockunier, S. H.
Eustis, F. A.
Frame, James
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Hutchinson, W. Spencer
Jones, William F.
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Packard, George A.
Richards, R. H.
Richards & Locke
Rogers, A. H.
Rogers, Mayer & Ball
Van Law, Carlos W.

**Michigan**

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Mines Efficiency Co.

**Missouri**

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Waring & Williams Laboratories, The
Wheeler, H. A.

**Montana**

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Estes, Frank M.
Indiana Laboratories Co., The
McCarthy & Co., Richard
Rohn, Oscar
Stewart & Wright

**Nevada**

Adamson, W. G.
Cox, Augustus D.
Hale, Fred A., Jr.
Lakeman, C. B.
Spencer & Co., L. B.

**New Jersey**

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Hatfield & Co.

**New Hampshire**

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Strain, J. H.

**New Mexico**

Lidstone & Van Dorp
Wright, Ira L.

**New York**

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Addicks, Lawrence
Aldridge, W. H.
Arnold, Ralph
Associated Petroleum Engineers
Ball, Sydney H.
Banks & Son, John H.
Bateson, C. E. W.
Beatty, A. Chester
Boise, Charles W.
Botsford, R. S.
Bradley, R. J. H.
Bradt, Harlan H.
Brockunier, S. H.
Brodie, Walter M.
Burdick, Charles A.
Burger, C. C.
Burrall, Fred'k P.
Channing, J. P.
Clapp, Fred. G.
Clark, Allen J.
Clements, J. Morgan
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Dwight & Lloyd Sintering Co.
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Finlay, J. R.
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Gill, Philip L.
Grugan, Justice
Guess, H. A.
Hager, Dorsey
Hammond, John Hays
Hampton, Wm. H.
Hassan, A. A.
Hendersen, H. P.
Holden, Edwin C.
Hooper, B. H.
Huntoon, L. D.
Hutchins, J. P.
Jaeger, Frederick
Keene, Amor F.
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Knox & Allen
Ledoux & Co.
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Li, K. C.
Lindberg, C. O.
Linton, Robert
Lloyd, R. L.
Loveman, M. F.
Mathewson, E. P.
Mayer, L. W.
McKinlay, William B.
Mead, H. L.
Megraw, Herbert A.
Minard, F. H.
Mulliken, H. S.
Newberry, Andrew W.
New York Testing Laboratories
Payne, C. Q.
Payne, Henry Mace
Perry, O. B.
Pitkin, Inc., L.
Poillon & Poirer
Ricketts, L. D.
Rogers, A. H.
Rogers, E. M.
Rogers, Mayer & Ball
Rowand, Lewis G.
Rutherford, Forest
Schroter, Geo. A.
Sharpless, Fred. F.
Shipp, E. Maltby
Simonds, F. M.
Strain, J. H.
Sussman, O.
Thayer, B. B.
Thomas, M. L.
Thomas, Kirby
Thomson, S. C.
Vandegrift, J. A.
Warriner, R. C.
Watson, R. B.
Weed, Walter Harvey
Weeks, Frederic R.
Westervelt, W. Y.
Whitman, Alfred R.
Wilkens & Devereux
Witherell, Chas. S.
Wolf, Harry J.
Yeatman & Berry

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Tucker, A. W.

**Ohio**

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Krejci, Milo W.

**Oklahoma**

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Cox, G. H.
Fohs, F. Julius
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Rutledge, J. J.

**Oregon**

Gilles, V. A.
Hodge, Edwin T.
Melzer, Emil

**Pennsylvania**

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Chance & Co., H. M.
Davis, G. C.
Demming, H. C.
Fuller, John T.
Garrey, George H.
Heinz, N. L.
Kennedy, Julian
Linton, Robert
Searle, Barry
Schafer, Wm.

**South Dakota**

Clark, Allan J.

**Tennessee**

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Southern Minerals Co.
Watson, Ralph A.
Darlington, W.

**Texas**

Anderson Engineering Co.
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Blackburn, W. D.
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Cole, David
Critchett & Ferguson
Ely, Fred B.
Harms, Ernest
Hassan, A. A.
Kinnon, Wm. H.
Kitson, H. W.
Schmidt, Henry C.

**Utah**

Bardwell, A. F.
Black & Deason
Crismon & Nichols
Cowan, Charles S.
Fitch, Walter, Jr.
Frank, Alfred
General Engineering Co.
Hilsdale, Paul
Krumb, Henry
MacViehie, D.
Officer & Co., R. H.
Sears, S. C.
Timmons, Colin
Union Assay Office, Inc.
Van Winkle, C. T.
Wilson, W. A.
Zalinski, E. R.

**Virginia**

Marshall, Stuart B.

**Washington**

Campbell, Wells & Elmendorf
Falkenburg & Co.
Greenough, W. Earl
Lachmund, Oscar
Lee, Chester
Levensaler, Lewis A.
Locke, Preston
Roberts, Milnor
Seward, John

**Wisconsin**

Royce, Stephen

**Wyoming**

McCarty, Edward P.

### CUBA

Constant Co., C. L.
Holden, Edwin C.
Murias, E. R. Suarez

### CANADA

**British Columbia**

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Fowler, S. S.
Hodge, Edwin T.
Munroe, H. S.
Stewart, Robert H.
Van Wagenen, H. R.

**Manitoba**

Allied Engineers, Ltd.

**Ontario**

Cohen, S. W.
Ferrier, W. F.
Graham, S. N.
Guess & Haultain
Murphy, Charles J.
Reid, J. A.
Rogers, John C.
Stevens, Frank G.
Thomas, D. R.
Tyrrell, J. B.
Watson, J. Craig
Whitman, Alfred R.

**Quebec**

Cohen, Samuel W.
Hersey Co., Ltd., Milton
Spearman, Chas.

**Yukon Territory**

Burrall, Fredk. P.

### MEXICO

Allen, Roy Hutchins
Babb, Percy Andrus
Burgren, Arthur W.
Burr, G. A.
Camphuis & Rives
Cruger, J. P.
Eveland, A. J.
Garza-Aldape, J. M.
Halter, Carl P.
Lucke, P. K.
MacDonald, Bernard
Moore, R. R.
Mulliken, H. S.
Nahl, A. C.
Pickering, J. C.
Saunders, T. S.
Shaw, S. F.
Steele, Heath
Stevens, Blamey
Tays, Eugene A. H.
Thomas, D. R.
Wilkens & Devereux

### AFRICA

Emery, A. B.

### ASIA

**China**

Draper, M. D.
Yung, M. B.

**Japan**

Mills, Edwin W.

### AUSTRALIA

Palmer, T. H.

### EUROPE

**England**

Arnold, Ralph
Ball, C. Leonard
Belmont, Arthur
Botsford, R. S.
Knox, Newton Booth
Purington, C. W.
Ridge Roasting Furnace & Engr. Co., The
Shaler, Millard K.
Tyrell, J. B.
Wilkens & Devereux

**France**

Richards, Gragg
Rivoiret, M. Raymond

**Italy**

Wright, Charles Will
Wright, Louis L.

**Servia**

Cook, Paul R.

**Siberia**

Purington, C. W.

**Spain**

Knox, Newton Booth

### CENTRAL AMERICA

Bancroft, H.

### SOUTH AMERICA

**Argentine**

Walker, Myron R.

**Bolivia**

Copeland, Durward
Easley, George A.
Harper, Harry A.

**Chile**

Lehmann, Charles
Strache, Walter
Strauss, Lester W.

**Columbia**

Caracristi, Charles, F. E.
Chèdé, L.
Parrish, K. C.
Ward, William F.

**Peru**

Klepetko, Frank
Neel, C. B.
Richards, Gragg.
Semple, C. Carleton

**Venezuela**

Caracristi, Charles, F. E.

# ARRANGED ALPHABETICALLY

A

**Adams, Huntington,** Mining Engineer. c/o White Weld & Co., 14 Wall St., New York City.

**Adamson, W. O.,** Mining Engineer and Metallurgist. Winnemucca, Nev.

**Addicks, Lawrence,** Consulting Engineer, 51 Maiden Lane, New York City. Cable: Galie, New York.

**Aldridge, Walter H.,** Mining and Metallurgical Engineer, 50 E. 42nd St., New York.

**Allen, Roy Hutchins,** Mining Engineer. Care of Cia. Union Minera del Refugio, S. A., Parral, Chih., Mex.

**Allied Engineers, Ltd.,** Mining Engineers and Geologists. Examinations, Exploration and Management in Manitoba Fields. The Pas, Man.

**Anderson, A. P.,** Consulting Mining Engineer, U. S. Smelting, Refining & Mining Company, 1504 Hobart Bldg., San Francisco, Cal.

**Anderson, G. E.,** Engineering Co., Geologists. Petroleum, Metals. 206 Anchor Bldg., Fort Worth, Texas.

**Arnold, Ralph,** Consulting Geologist and Petroleum Engineer. Union Oil Building, Los Angeles, Calif., 25 Broad St., New York City. No. 1 London Wall Building, London, E. C. Cable: "Ralfarnoil."

**Associated Petroleum Engineers** (successors to Assoc. Geol. Engrs), F. G. Clapp, Chief Geologist. 30 Church St., New York.

**Ayres, W. S.,** Min. and Mech. Eng. Consultation, Examination, Reports. Long Experience as Manager of Iron and Coal Mines, Hazelton, Pa.

B

**Babb, Percy Andrus,** Mining and Metallurgical Engineer. Apart. No. 92, Pachuca, Hgo., Mexico.

**Ball, C. Leonard,** General Manager, Cia Huanchaca De Bolivia, Puiacayo, Bolivia.

**Ball, Sydney H.,** Mining Geologist, Rogers, Mayer Ball, 42 Broadway, New York City. Cable Address: Alhasters.

**Bancroft, Howland** Consulting Mng. Geologist. Mgr. Sinclair Panama Oil Corp., Panama City. Rep. of Panama. Cable: "Howban." Code: Bedford-McNeill.

**Banks & Son, John H.,** Mining Engineers and Metallurgists. 26 John St., New York. Examinations and Management. Special attention to problems in ore treatment. Formerly of the late firm of Ricketts & Banks.

**Bardwell, A. F.** (successor to Bettles & Bardwell), Custom Assayer and Chemist. 158 South West Temple St., Salt Lake City, Utah.

**Barry, John G.,** Mining Geologist, Mills Building, El Paso, Texas.

**Barton, L. A.,** Petroleum Engineer. 404 Hutchinson Bldg., Shreveport, La.

**Bates, Mowry,** Petroleum Engineer and Geologist, 305 Atco Bldg., Tulsa, Okla.

**Bateson, C. E. W.,** Consulting Mining Engineer and Geologist. 68 William Street, New York, c/o Ricketts & Company, Inc., formerly with Ricketts & Banks.

**Beaudette, A. J.,** Mining Engineer, 252 Russ Bldg., San Francisco, Calif.

**Beam, A. Mills,** Metallurgical and Consulting Engineer, 807 Central Savings Bank Bldg., Denver, Colo.

**Beatty, A. Chester,** Consulting Mining Engineer, 25 Broad St., New York. Cable: Granitic. No professional work entertained.

**Bell, Charles N.,** Consulting Mining Engineer. The Metals Exploration Co., 201 Fourteenth St., Denver, Colo.

**Belmont, Arthur,** Consulting Mining Engineer, 3 Mincing Lane, London, E. C. 3, England. Cable Address "Beldurel-London."

**Bjorge, Guy N.,** Mining Geologist. 788 Mills Bldg., San Francisco, Calif.

**Black & Deason,** Assayers and Chemists. 165 South West Temple St., Salt Lake City, Utah.

**Blackburn, W. D.,** Mining Engineer. 1012 McGregor Ave., Houston, Texas.

**Boise, Charles W.,** Mining Engineer. Foreign Exploration. Room 1507-14 Wall St., N. Y. Cable: "Mukeba."

**Botsford, C. W.,** Consulting Mining Engineer and Geologist. Room 2093, 214 O'Neill Bldg., Phoenix, Arizona.

**Botsford, R. S.,** Mining Engineer. Room 2983, No. 50 Church St., New York City and 2 Drapers Gardens, London, England.

**Bradley, R. J. H.,** Consulting Mining Engineer. Room 1033, 149 Broadway, New York. Cable Address: 'Investigate." Code: Bedford-McNeill.

**Bradt, Harlan H.,** Mining Geologist and Engineer. 261 Rockingstone Avenue, Larchmont, N. Y. Telephone Larchmont 875.

**Brockunier, S. H.** 11 Nesmith St., Lowell, Mass.

**Brodie, Walter M.,** Mining Engineer and Metallurgist. Room 904, 47 Cedar St., New York.

**Burbidge, Frederick,** Mining Engineer. Wallace Idaho.

**Burch, Hershey & White,** Albert Burch, O. H. Hershey, Lloyd C. White, Consulting Mining Engineers. Crocker Bldg., San Francisco. Cable Address: "Burch," San Francisco. Usual codes.

**Burch, H. Kenyon,** Consulting Engineer, Phelps, Dodge Corpn. (Address) Copper Queen Branch, Bisbee, Ariz.

**Burdick, Charles A.,** Mining Engineer. Equitable Bldg., 120 Broadway, New York. Phone: Rector 1645.

**Burgren, Arthur W.,** Mining Engineer, with American Smelting & Refining Co., Matehuala, Est., San Luis Potosi, Mexico.

**Burger, C. C.,** Consulting Mining Engineer. 71 Broadway, New York.

**Burgess, John A.,** Mining Engineer and Geologist. General Manager United Eastern Mining Co., Oatman, Arizona.

**Burlingame, Walter E.,** Est. 1866. Assayer and Chemist, Bullion Dealer, Ore Shippers' Agent, Ore Testing, 1736 Lawrence St., Denver, Colo.

**Burns, William,** Mining Engineer. 788 Mills Bldg., San Francisco, Calif.

**Burr, Gmo. A.,** E. M. C. E. Geological Surveys and Mine Examinations in Mexico exclusively. San Luis Potosi, S. L. P. and Guachinango, Jalisco.

**Burrall, Frederick P.,** Mining Engineer. Dawson, Yukon Territory, Canada, 36th Floor, 233 Broadway, New York.

C

**Callow, J. M.,** Pres. General Engineering Co., Consulting Metallurgical Engineers, Room 3022, No. 120 Broadway, New York, 159 Pierpont St., Salt Lake City, Utah, U. S. A.

**Cameron, Geo. W.,** Assayer and Chemist. Representative for shippers to the El Paso Smelter, 205 San Francisco St. Box 489, El Paso, Tex.

**Campbell, Wells & Elmendorf,** Mining Engineers, Chemists, Metallurgists. Mining Examinations and Management, Umpires and Control Assayers, Ore Testing and Metallurgical Processes. Prefontaine Bldg., Seattle, Wash.

**Caracristi, Charles F. Z., Col.,** Economic Geologist. Latin-American reports and developments. Caracas, Venezuela.

**Carpenter, Alvin B.,** Mining Engineer. Examinations, Consultation, Supervision of Mines. 530 Citizens National Bank Bldg., Los Angeles, Calif.

**Carpenter, Jay A.,** Consulting Metallurgical Engineer. Office and Laboratory at 1006 S. Hill St., Los Angeles, Calif.

**Carpenter, Miles Miller,** Mining Engineer, U. S. Mineral Surveyor, Examinations, Consultation. Tucson, Ariz.

**Chance & Co., H. M.,** Coal and Iron, Consulting Engineers, Drexel Building, Philadelphia, Penn.

**Channing, J. Parke,** Consulting Engineer, 61 Broadway, New York.

**Chase, Charles A.,** Mining Engineer, 825-826 Cooper Building, Denver, Colo. Liberty Bell G. M. Co., Telluride, Colo.

**Chase & Son, Edwin E.,** Edwin E. Chase, R. L. Chase, Mining and Geological Engineers, 207 Colorado National Bank Bldg., Denver, Colo.

**Chèdé, L.,** Ingenieur des Mines. Long experience Colombian properties, Examinations, Reports, Purchases. Cali, Republic of Colombia.

**Clapp, Frederick G.,** Consulting Geologist and Petroleum Engineer, 30 Church St., New York City.

**Clark, Allan J.,** Metallurgical Engineer. Care Homestake Mining Co., Lead, South Dakota and 10 Cotton Exchange, New York.

**Clark, Baylies C.,** Mining and Mechanical Engineer. Sutter Creek, Calif. Cable Address: "Baclark." Code: Bedford-McNiell.

**Clausen, Carl,** Engineer, Bisbee, Arizona. Design and erection of mills for concentration, amalgamation, cyaniding, etc. Smelters and Power Plants

**Clements, J. Morgan,** Mining Engineer and Geologist, 20 Broad St., New York. Code: Bedford-McNeill.

**Cohen, Samuel W.,** Consulting Min. Eng., Dominion Express Bldg., Montreal, Canada.

**Cole, David,** Specialist in Ore Concentration. Mining Mechanism and Property Management. 1210 Mills Bldg., El Paso, Texas.

**Cole & Co.,** Assayers, Chemists, Ore Buyers. Box BB, Douglas, Ariz.

**Collins, Edwin James,** Mining Engineer and Mining Geologist. Examinations and Management. Torrey Bldg., Duluth, Minn.

**Collins, George E.,** Min. Eng. Mine Examinations and Management, 307 Boston Bldg., Denver, Colo. Cable Address: "Colcamac," Denver.

**Collins, Glenville A., Engineers, Ltd.,** Consulting Mining and Civil Engineers, 409-10 Credit Foncier Bldg., Vancouver, B. C.

**Colvocoresses, George M.,** Mining Engineer. General Manager, Consolidated Arizona Smelting Co., Humboldt, Ariz.

**Constant Co., C. L.,** Mining, Metallurgical and Chemical Engineers. New York Office, 220 Broadway, New York, N. Y. Cuban Office, Amargura 23, Havana, under J. C. Porter. Registered Mining Engineer under Cuban law.

**Cook, Paul R., E. M.** Mining Engineer, Balkan States, 43 Maria Louisa, Sofia, Bulgaria.

**Copeland, Durward,** Metallurgical Engineer, Missouri School of Mines, Rolla, Mo., and Llallagua, Bolivia, South America.

**Cowan, Charles S.,** successor to Bird-Cowan Co., Custon Assayer and Chemist. 160 S. W. Temple St., Salt Lake City, Utah.

**Cox, Augustus D.,** Mining Engineer. Clay Peters Bldg., Reno, Nev.

**Cox, W. Rowland, and Staff,** Consulting Specialists, Management, Operation and Examination of Mines and Mills, 120 Broadway, New York.

**Cranston, Robert E.,** Min. Eng., 582 Market St., San Francisco, 2 Rector St., New York. Cable Add.: "Recrans" Code: McNeill's, 1908.

**Creden, William L.,** Consulting Mining Engineer. Mine Examinations and Management. Room 405, Daly Bank Bldg., Butte, Mont.

**Crismon & Nichols,** Assayers and Chemists, 229-231 South West Temple St., Salt Lake City., P. O. 78.

**Critchett & Ferguson,** Assayers and Chemists. Agents for Ore Shippers. Umpire and Control a Specialty. El Paso, Texas.

**Cruger, James P.,** Mining Engineer. Twenty years Mexico. Examinations anywhere. Address Guanacevi, Dgo., Mexico.

D

**Dahl & Wartenweiler,** Engineers, Designers, and Builders of Mine, Metallurgical an dIndustrial Plants. Central Bldg., Los Angeles, Cal.

**Darlington, Wayne,** Consulting Mining Engineer and Metallurgist. 50 North 23rd St. Philadelphia, Penn.

**Davis, Geo. C.,** Metallurgical Chemist, Analysis of Alloys, Iron, Coal, Sand and Minerals. Calorific Value of Coal, 636 Race St. Philadelphia.

**Davis, Leverett,** Mining Engineer, 911 Foster Bldg., Denver, Colo.

**Demming, Henry C.,** Min. Eng. Geologist, Mineralogist and Chemist. Offices and Laboratory. 15-17 N. 3rd St., Harrisburg, Penn., U. S. A.

**Dennis, Clifford G.,** Mining Engineer. Crocker Bldg., San Francisco, Calif. Cable: "Sinned." Code: Bedford-McNiell.

**Draper, Marshall D.,** Mining Engineer, Kotchiu, Yunnan, China. Parmanent Address: 213 Boston Bldg., Denver, Colo.

**Drew, C. V., E. M.,** with Cerro de Pasca Copper Corporation, Room 4, fifth floor, 15 Broad St., New York.

**Dudley, H. C.,** Mining Engineer. 704 Lonsdale Bldg., Duluth, Minn.

**Duncan & Lindley,** Mechanical Engineers for Mines and Mills. 649 Mills Bldg., San Francisco, Cal.

**Dunning, Charles H.,** Mining Engineer. Prescott, Ariz.

**Dunster, Carl B.,** Mining Engineer. Rockefeller Building, Cleveland, Ohio.

**Dwight, Arthur S.,** Mining Engineer and Metallurgist. 29 Broadway, New York. Cable address: "Sinterer."

**Dwight & Lloyd** Sintering Company. Special Problems in Ore Treatment, 29 Broadway, New York City. Cable address: "Sinterer."

E

**Easley, Geo. A., M. E.** La Paz, Bolivia, South America. Cable Address: "Easley," La Paz

**Easton, Stanly A.,** Mining Engineer. Manager, Bunker Hill & Sullivan Mining and Concentrating Co., Kellogg, Idaho.

**Ely, E.,** Prop. Dover Laboratory. Analysts, Assayers. Reports, Gold Assay $2.00 Iron det. $1.00, Phos. $1.50, Dover, New Jersey.

**Ely, Fred B., Petroleum and Mining Geologist** Box 1369, Fort Worth, Texas.

**Emery, A. B., Mining Engineer, Messina, Transvaal.** Tele. and Cable Address: Abemery, Messina, Transvaal.

**Emlaw, H. S., Mining Engineer.** 36th Floor 233 Broadway, New York City, and Trona Calif.

**Erdlets, Jr., Joseph F. B., Mining Engineer, 61** Broadway, New York. Cable Address: Branderlet, New York.

**Ermlich, Geo. J., & Co., Assayers and Chemists.** Control and Umpire Work. Ore Shipper's Agent. 1727 Champa St., Denver, Colo.

**Estes, Frank M., Mining Engineer, Manager** Revenue Mines, Inc., Norris, Montana.

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**Farish, John R., Mining Engineer.** Office, 58 Sutter St., San Francisco, Calif. Residence San Mateo, Calif. Cable Address: "Farish."

**Ferrier, W. F., Consulting Mining Engineer and** Geologist. 204 Lumsden Bldg., Toronto, Ont.

**Fesing, Herman W., Mining Engineer.** Lake Superior Copper and Iron Examinations, Houghton, Mich.

**Finch, John Wellington, Mining Geologist and** Engineer, 14 Wall St., New York.

**Finlay, J. R., Mining Engineer.** Room 1410. 170 Broadway, New York.

**Fisher, C. A., Consulting Geologist and Fuel En**gineer, 906 1st Nat. Bank Bldg., Denver, Colo.

**Fitch, Walter, Jr., Shaft and Tunnel Contrac**tors, Eureka, Utah.

**Flagg, Arthur Leonard, Consulting Engineer.** 408 Fleming Building, Phoenix, Ariz.

**Fohs, F. Julius, Consulting Oil Geologist.** Tulsa, Okla., 1st Nat. Bk. Bldg. New York City, 60 Broadway. Cable address: Fohsoil. Codes: Bedford, McNeil & Bentley.

**Fowler, Samuel S., Mining Engineer and Metal** lurgist. Nelson, British Columbia.

**Fox, John M., Mining Engineer.** 324 Holbrook Bldg., San Francisco, Cal.

**Frame, James, Mining Engineer and Geologist,** Room 607, 53 State St., Boston, Mass.

**Frank, Alfred, Mining Engineer, 1121 Newhouse** Bldg., Salt Lake City, Utah.

**Frost, Oscar J., Assayer & Chemist.** 1310-12 17th Ave., P. O. Box 145, Denver, Colo.

**Fuller, John T., Mining Engineer.** American Bauxite Co., Bauxite, Ark. Permanent address. 1306 Main St., Honesdale, Pa.

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G

**Gahl, Rudolf, Consulting Metallurgist, special**izes in concentration, flotation and leaching of copper ores. 804 Equitable Bldg., Denver, Colo.

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**Gill, Phillip L., Metallurgical Engineer.** Specialties: Copper; Industrial Examinations; Reports. 275 Broadway, New York City.

**Gilles, V. A., Mining Engineer, Monitor, Oregon.**

**Graham, Stanley N., Mining Engineer, Mining** and Metallurgical Dept., Queens University, Kingston, Ont., Canada.

**Grant, Wilbur H., Geologist and Mining Engi**neer. Code: Bedford-McNeill. 1213 Hobart Bldg., San Francisco, Calif.

**Greenough, W. Earl, Consulting Mining Engi**neer. Old Nat. Bank Bldg., Spokane, Wash.

**Grugan, Justice F., Mining Engineer, 135 Broad**way, New York. Cable address: Jusgrugan, New York.

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**Hammond, John Hays, Consulting Engineer, 120** Broadway, New York, Code: Bedford-McNeill.

**Hampton, William H., Mining & Civil Engineer;** Chemist; Metallurgist; Water Supply; Electric Furnaces; Developments. 1270 Broadway, N. Y. City.

**Hanks, Abbot A., Control and Umpire Assays.** Ore Shippers' Agent, Analyses of Ores, Minerals, etc. 624 Sacramento St., San Francitsco, Calif.

**Hardy, J. Gordon, Mining Engineer, 413 River**bank Court, Cambridge, Mass.

**Harms, Ernest, Metallurgical Engineer.** 902 Upson Ave., El Paso, Texas.

**Harper, Harry A., Mining Engineer, Exploration** and Development, c/o International Machinery Co. La Paz, Bolivia. Cable: Harper. Bedford-McNeill.

**Hassan, A. A., Consulting Geologist and Engi**neer of Mines, Westbrook Hotel Bldg., Fort Worth, Texas. Any Code. Cable Address "Hassan."

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**Hersey Co., Ltd., Milton, Mining Engineers. Con**sultation, Examination and Management. 84 St. Antoine St., Montreal, Can. Cable: "Milhersey"—Bedford-McNeill Code.

**Hess, Rush M., Mining Engineer. Examination.** Consultation, Supervision. 807 Brown-Marx Bldg., Birmingham, Ala. Cable: "Rumihe, Code Bedford-McNeill."

**Hilsdale, Paul, Mining Engineer, 821 Newhouse** Bldg., Salt Lake City, Utah.

**Hills, Victor G., Mining Engineer. McPhee Bldg.,** Denver, Colo.

**Hodge, Edwin T., Consulting Geological and** Mining Engineer, Standard Bank Bldg., Vancouver, B. C., and Department of Geology. Uitversity of Oregon, Eugene, Oregon.

**Hodges, A. B. W., Mining and Metallurgical En**gineer. 109 South Kingsley Drive, Los Angeles, Cal.

**Hoffmann, Ross B., Mining Engineers, 228 Perry** St., Oakland, Calif. Cable Address: "Rosshof."

**Holden, Edwin C., Consulting Mining Engineer,** 1100 Garrett Bldg., Baltimore, Md. "Code: Bedford-McNeill. Cable: "Nedioh." Baltimore.

**Holland, L. F. S., Mining Engineer, 1718 La Brea** Avenue, Hollywood, Cal.

**Hollis, H. L., Consulting Mining Engineer and** Metallurgist. 1025 Peoples Gas Building., Chicago, Ill.

**Hooper, G. H., Graphite Miing and Refining a** Specialty. Whitehall, N. Y.

**Hopkins, C. V., 987 S. Magnolia Ave., Los** Angeles, Cal.

**Huntoon & Van Arsdale, Louis D. Huntoon. G. D.** Van Arsdale, Mining Engineers, 115 Broadway, New York City.

**Hunt & Co., Robert W., Mining Engineers. Ex**aminations and Reports of Properties and Processes, Development of Properties, Consultation Assayers and Chemists, Inspection and Tests Materials, Machinery and Structural Steel for Structures. Chicago, Ill.

**Hutchins, J. B., Mining Engineer. 120 Broad**way, New York City, N. Y.

**Hutchinson, Randolph B., Mining Engineer.** 1008 Central Building, Los Angeles, Calif.

**Hutchinson, W. Spencer, Mining Engineer. 201** Devonshire St., Boston, Mass.

I

**Indiana Laboratories Co., The, Shippers' Rep**resentative. Weighing, Sampling, Assaying. Hammond, Ind. Phillipsburg, Mont.

**Innes, Murray, Mining Engineer, Oceanic Quick**silver Mine, Cambria, Calif.

J

**Jaeger, Frederick, Chemist and Metallurgist.** Specialty: Copper refining and manufacturing of sodium cyanide. 17 Gramercy Park, New York City.

**Jenks, T. H., Con. Min. Eng., 1221 Royal Court,** Los Angeles, Cal. Codes: Bedford-McNeil, Moreing & Neal.

**Jones, C. Colcock, Mining Engineer. 917 Invest**ment Bldg., Los Angeles, Calif. Code: Bedford-McNeill.

**Johnes, William F., Oil and Coal examinations,** topographic and geologic mapping. West indian and Central American explorations. 222 Charles River Road, Cambridge, Mass.

**Jüssen, Edmund, Mining Engineer. 2546 Warring** St., Berkley, Cal. Code: Bedford-McNeill.

K

**Keene, Amor F., Consulting Engineer.** 233 Broadway, New York. Cable Address: Kamor, New York.

**Keeney, Robert M., Consulting Metallurgical En**gineer. Design, Construction and Operation of Electric Smelting Plants. Somersville, Conn.

**Kennedy, Julian, Engineer.** The Bessemer Building, Sixth St. and Duquesne Way, Pittsburgh, Penn. Cable Address: "Engineer," Pittsburgh.

**Kepner, R. B., Consulting Mining Engineer.** Examinations supervision of Mining Operations, 718 Washington Bldg., Los Angeles, Cal.

**Kinnon, William H., Mining Engineer and Metal**lurgist. 801 Arizona St., El Paso, Texas.

**Kinzie, Robert A., Mining Engineer.** First National Bank Building, San Francisco, Calif.

**Kirby, Edmund B., Mining and Metallurgical** Engineer. 918 Security Bldg., St. Louis, Mo.

**Kitson, H. W., Mining Engineer and Geologist.** 1209 Mills Bldg., El Paso, Texas.

**Klepetko, Frank, Mining and Metallurgical En**gineer, 80 Maiden Lane, New York, and Apartado 708, Lima, Peru.

**Krejci, Milo W., Consulting Metallurgical Engi**neer. Smelting and refining of copper and lead. 541 Society for Savings Building, Cleveland, Ohio.

**Knox, Newton Booth, 75b Queen Victoria St.,** London and at Noya, Spain. Cable Address: "Flueblower," London.

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**Lakenan, C. B., Mining Engineer. McGill, Nev.**

**Lasier, Frederick G., Mining Engineer. Holly,** Mich., or care Detroit Club, Detroit, Mich.

**Lawton, Nathan O., Mining Engineer. Mining** Methods, Management, Examinations and Reports. Years of Experience. Code: Bedford-McNeill. Res. and Forwarding Address, Lawton, Mich.

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**Lehmann, Charles, Mining Engineer. Examina**tion and Management of Properties. Casilla, 1364, Santiago, Chile, S. A.

**Le Fevre, S., Consulting Mining Engineer. Mag**netic Iron Ore, Testing Laboratory Available Forest Glen, Ulster County, N. Y.

**Leonard Engineering Co., Mining Engineers,** Chemists, Assayers, Metallurgists. P. O. Box 172, Boise, Idaho.

**LeVasseur, Charles,** Cons. Mining Engineer, Examinations, Surveys, Reports, Development and Management of Mines. Yellville, Ark. Joplin, Mo.

**Levensaler, Lewis A.,** Mining Engineer. 901 Hoge Bldg., Seattle, Wash.

**Lidstone & Van Dorp,** Mining and Metallurgical Engineers. Examinations and Management. Silver City, N. M.

**Lindberg, Carl O.,** Mining Engineer. 1211 Hollingsworth Building, Los Angeles, Calif.

**Lindsley, Thayer,** Mining Geologist. Peterboro, N. H.

**Linton, Robert,** Mining Engineer, 120 Broadway, New York. Union Arcade, Pittsburgh, Penn. Code: Bedford-McNeill.

**Lloyd, R. L.,** Metallurgical Engineer. Specialty Pyrometallurgy of Copper and Associated Metals. 29 Broadway, New York. Cable Address: "Ricloy, New York." Codes: Bedford-McNeill and Miners & Smelters.

**Locke, Augustus,** Mining Geologist. 788 Mills Bldg., San Francisco, Calif.

**Locke, Preston,** Resident Mining Engineer American Smelting & Refining Co., American Smelters Securities Co., White Building, Seattle, Washington.

**Long, Frederic H., Consulting Mining and Metallurgical Engineer.** 38 So. Dearborn St., Chicago, Ill.

**Longyear Co., E. J.,** Exploring Engineers Diamond Core Drilling, Shaft Sinking and mine Development. Diamond Drill Manufacturing. Security Bldg., Minneapolis, Minn. Cable Address: "Longco." Code: Bedford-McNeill.

**Loveman, Michael H.,** Mining Geologist, c/o Goldfields American Development Co., 233 Broadway, New York.

**Lucke, P. K.,** Consulting Mining Engineer. Avenida Isabel la Catolica 25, Mexico City. Cable Address: Lucke, Mexico City.

M

**MacBoyle, Errol, Mining Engineer and Geologist.** 1113 Hobart Bldg., San Francisco. Cable: "MacBoyle," San Francisco. Usual Codes.

**MacDonald, Bernard,** Mining and Metallurgical Engineer. Supt. Veta Grande Unit of the American Smelters Securities Co., Parral, Chih., Mexico. Code: Bedford-McNeill.

**MacVichie, D.,** Mining Engineer. 916 Boston Bldg., Salt Lake City, Utah.

**McBride, Wilbert G.,** General Manager, Old Dominion Co., Globe, Ariz.

**McCarthy & Co., Richard,** Assayers, Chemists and Metallurgists. 56 East Granite St., Butte, Mont.

**McCarthy, Edward P.,** Consulting Mining Engineer. Specialty: Iron and manganese mining. University of Wyoming, Laramie, Wyo.

**McConnell, Robert E.,** Consulting Mining Engineer. 1208 Hollingsworth Bldg., Los Angeles, Cal.

**McGregor, A. G.,** Engineer. Design of Metallurgical Plants. Warren, Ariz.

**McKinlay, William B.,** Mining Engineer. 506 So. Broadway, Yonkers, N. Y.

**Marsh, Austin G.,** Mining Engineer and Metallurgist, with the Pueblo Mining & Metallurgical Co., 123 N. Santa Fe Ave., Pueblo, Colo.

**Marshall, Stuart B.,** Consulting Engineer. Manganese, coal, iron, minerals, furnaces, etc. Roanoke, Va.; Washington, D. C.

**Mathewson, E. P.,** Consulting Engineer. Non-Ferrous Metallurgy. 42 Broadway, New York.

**Mayer, Lucius W.,** Mining Engineer. Rogers, Mayer & Ball, 42 Broadway, New York. Cable Address: Alhasters.

**Mead, H. L.,** Mining Engineer. American Cyanamid Co., 511 Fifth Ave., New York.

**Megraw, Herbert A., Metallurgical Engineer.** Kennedy-Van Saun Mfg. & Eng. Corp., 120 Broadway, New York.

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**Mines Efficiency Co.,** Geological, Mining and Metallurgical Engineering. 709 Alworth Bldg., Duluth, Minn.

**Mitke, Charles A.,** Consulting Mining Engineer. Mining Methods, Mine Ventilation. Bisbee, Ariz.

**Mohave Assay and Engineering Office,** R. C. Jacobson, I. C. Stricker. Mining Chemists and Engineers. Ore Testing Laboratory. Mining Reports, Mill Design, Mine Management. Kingman, Ariz.

**Moore, R. R.,** Consulting Engineer and Metallurgist. Aguascalientes, Mexico.

**Morris, F. L.,** Mining Engineer. 1057 Monadnock Bldg., San Francisco, Calif. Cable: "Fredmor." Code: Bedford-McNeill.

**Mudd, Seeley W.,** Mining Engineer. 1208 W. I. Hollingsworth Bldg., Los Angeles, Calif. Code: Bedford-McNeill.

**Mulliken, H. S.,** Consulting Metallurgist. Address Bureau of Mines, Washington, D. C. No professional engagements undertaken at the present time.

**Munroe, H. S.,** Mining Engineer. Anyox, British Columbia.

**Murphy, Chas. J.,** B. A. Sc. Engineering Service "The World is My Territory." St. Catherines, Ont., Canada.

**Murias, E. R. Suarez,** Mining Engineer and Geologist. Examinations and reports. Bank of Nova Scotia Bldg., Havana, Cuba.

**Myers, Desaix B.,** Mining Engineer. 433 Merchants National Bank Bldg., Los Angeles, Calif.

N

**Nahl, Arthur C., Consulting Engineer.** Care of Bocholl Ruffo & Co., La Paz, Baja California, Mexico.

**Neel, Carr B.,** Mining Engineer, Mineria 189, Lima, Peru, S. A. Cable: Carrneel, Lima. Bedford-McNeill Code.

**Newberry, Andrew W.,** Mining Engineer, 2 Rector St., New York City.

**Newman, M. H.,** Mining Geologist, c/o American Zinc, Lead & Smelting Co., Mascot, Tenn.

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P

**Packard, George A., Mining Engineer and Metallurgist.** 50 Congress St., Boston, Mass. Cable Address: "Geopack," Boston.

**Palmer, T. H.,** B. E., Fel. Chem. Soc., etc., Consulting Engineer. Valuing, Organizing, Technical Advice, Mining, Metallurgy, Flotation and Selective Flotation Processes. Collins House, Melbourne. Cable: "Remlap," Melbourne.

**Palmer, William F.,** Mining Engineer. Examinations and reports. Eastern Office, 15 Broad St., N. Y. Western Office, 1350 Highland Ave., Hollywood, Cal.

**Parrish, K. C.,** Mining Engineer. Apartado No. 6, Baranquilla, Colombia, So. America. Cable Address "Parrish."

**Patton, Horace B., Ph.D.,** Oil and Mining Geologist; 24 years Professor of Geology of Colorado Schools of Mines. 911 Foster Bldg., Denver, Colo.

**Payne, C. Q.,** Mining Engineer. 82 Beaver St., New York.

**Payne, Henry Mace, Consulting Mining Engineer,** Machinery Club, 50 Church St., New York City. Cable Address: "Macepayne," N. Y.

**Pefley, W. Wallace, Mining Engineer & Geologist.** Union Block, Boise, Idaho.

**Perry, O. B.,** Mining Engineer. 120 Broadway, New York.

**Pickering, J. C., Consulting Mining Engineer.** Avenida Juarez 83, Mexico City, Mexico. Cable Address: "Keringpec."

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**Plate, H. Robinson,** Mining Engineer. Examinations, Development and Management. Hobart Bldg., San Francisco, Calif. Code: Bedford-McNeill.

**Poillon & Poirer,** Howard Poillon, C. H. Poirer. Mining Engineers. 42 Broadway, New York.

**Probert, Frank H.,** Mining Engineer. University of California. Berkeley, Calif.

**Purington, C. W.,** Mining Engineer. 5 Sodomsky Pereulok, Vladivostok; 6 Copthall Ave., London.

R

**Radford, Walter J.,** Mining Engineer. Examination of Dredging and Placer Gravels. 702 N. Cascade Avenue, Colorado Springs, Colorado.

**Rakowsky, Victor,** Mining Engineer in the development Miami Zinc Fields, Oklahoma. Address: Joplin, Mo. Code: Bedford-McNeill.

**Reece, P. P.,** Mining Engineer. Specialty: Coal. Melcher, Marion Co., Iowa.

**Reed, Avery H.,** Mining Engineer. Zinc and lead ores. Fluorspar. Marion, Ky.

**Reid, J. A.,** Mining Engineer. O'Brein Mine, Cobalt, Ont.

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**Ritter, Etienne A.,** Mining Engineer and Geologist. Colorado Springs, Colo.

**Rivoiret, M. Raymond,** Ingenieur des Mines. Mortain, Manche, France.

**Roberts, Milnor,** Mining Engineer. The Pacific Northwest British Columbia and Alaska, University Station, Seattle, Wash.

**Rogers, Allen Hastings,** Consulting E. M. 201 Devonshire St., Boston, Mass. 42 Broadway, New York. Cable Address: Alhasters, N. Y.

**Rogers, Edwin M., Consulting Mining Engineer,** 32 Broadway, New York, N. Y.

**Robertson, Jasper T.,** Mining Engineer. 1108 Hobart Bldg., San Francisco, Calif.

**Rogers, John C.,** Mining Engineer. Examination and exploration of mining properties with a view to purchase. Copper Cliff, Ont.

**Rogers, Mayer & Ball,** Allen H. Rogers, Lucius W. Mayer, Sydney H. Ball, Mining Engrs. 42 Broadway, N. Y. 201 Devonshire St., Boston, Mass. Cable: "Alhasters."

**Rohn, Oscar,** Mining Engineer and Geologist. Butte, Mont., care East Butte Copper Min. Co.

**Roller, Arthur H.,** Mining and Metallurgical Engineer. Mine examinations, ore treatments and management. 438 Equitable Bldg., Denver, Colo.

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**Royce, Stephen,** Consulting Mining Engineer and Geologist, Exploration, Operating, Valuation, Examination. Science Hall, Madison, Wis. Mining Office & Residence, Crystal Falls, Mich.

**Royer, Frank W., Mining Engineer.** 321 Cons. Realty Bldg., Los Angeles, Calif. Code Word: Royo. Codes: Smelters, General, Bedford-McNeill.

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S

**Saunders, T. Skewes,** Mining Engineer, University Club, Bucareli 35, Mexico City, Mexico.

**Schmidt, Henry C.;** Examination and Management. Apartment 12, The Rosemont, El Paso, Texas.

**Schroter, Geo. A.,** Mining Engineer. 111 Broadway, New York

**Schwerin, Martin,** Mining Engineer. General Manager Spar Mountain Mining Company, Cave-in-Rock, Hardin County, Illinois.

**Searle, Barry,** Chemist and Min. Eng. Consultation, Examination and Management. Montrose, Penn. Codes: Bedford-McNeill. A. B. C.

**Sears, Stanley C.,** Mining Engineer. Consultation, Examination and Management: 705 Walker Bank Bldg., Salt Lake City, Utah. Usual Codes.

**Semple, C. Carleton,** Mining Engineer and Metallurgist. Care of Rocca & Miller, Lima, Peru, So. Am.

**Seward, John,** Mining Engineer. 1416 Madison St., N. W., Washington, D. C.

**Shaler, Millard K.,** Mining Geologist and Engineer, 6 Rue des Colonies, Brussels, Belgium.

**Sharpless, Fred'k F.,** Mining Engineer. 115 Broadway, New York. Cable Address: "Fresharp," N. Y. Bedford-McNeill Code.

**Shaw, S. F.,** Mining Engineer. Cia. Minera La Constancia, Sierra Majada, Coahuila, Mexico.

**Shipp, E. Maltby,** Consulting Mining, Metallurgical Engineer and Timberland Factor. 115 Broadway, New York City.

**Short, Frank R.,** Mining Engineer, 1057 Monadnock Bldg., San Francisco. Cable Address: "Muskeg."

**Sill & Sill** Mining and Metallurgical Engineers. Examinations, Management. Geological Surveys. 1011 Figueroa St., Los Angeles, Calif.

**Simonds, F. M.,** Mining Engineer. 25 Madison Ave., New York.

**Slak, John,** Consulting Mining Engineer. Examinations reports, management, exploration, advice to investors in mining properties. Mayer, Arizona.

**Smith, Gordon C.,** Examinations, Patents, Geological Mapping. Idaho Bldg., Boise, Idaho.

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**Spence, Harold,** C. E., Consulting Engineer. Coal and Oil Shale Distillation Specialty. Duncan, Ariz.

**Spencer, L. B.,** Mining Engineer. Reports on Nevada Mines. Mina, Nev.

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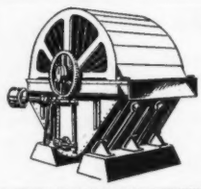

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**Desulphurizers, Ore**
Vulcan Iron Works

**Dewaterers**
Oliver Cont. Filter Co.

**Diamonds, Black (See "Carbons and Bortz")**

**Dragline Excavators**
Bucyrus Co.

**Dredges**
Bethlehem Shipbuilding Co.
Flory Mfg. Co., S.
Marion Steam Shovel Co
New York Engineering Co.
Osgood Co.
Union Construction Co
Yuba Mfg. Co.

**Dredges, Dipper and Hydraulic**
Bucyrus Co.

**Dredges, Elevator**
Marion Steam Shovel Co.

**Dredges, Placer**
Bucyrus Co.

**Dredging Machinery**
Lidgerwood Mfg. Co.

**Drilling, Core**
Ameling Prospecting Co., Inc
Ingersoll-Rand Co
Longyear Co., E. J.
McKiernan- Terry Drill Co
Pennsylvania Drilling Co
Smith & Travers Co., Ltd.
Sullivan Machy. Co.

**Drills Churn**
Union Construction Co.

**Drills, Core**
Dobbins Core Drill Co.
Ingersoll-Rand Co.
Longyear Co., E. J.
McKiernan-Terry Drill Co
Sullivan Machy. Co.

**Drills, Diamond**
Longyear Co., E. J.
Sullivan Machy. Co.

**Drills, Electric**
Chicago Pneumatic Tool Co
General Electric Co.
Ingersoll-Rand Co.
Jeffrey Mfg. Co., The

**Drills, Hammer**
Chicago Pneumatic Tool Co
Cochise Machine Co.
Denver Rock Drill Mfg. Co
Ingersoll-Rand Co.
McKiernan-Terry Drill Co
Sullivan Machy. Co.
Whitcomb & Co., Geo. D

**Drills, Piston**
Cochise Machine Co.
Ingersoll-Rand Co.
Sullivan Machy. Co.

**Drills, Prospecting**
Ingersoll-Rand Co.
Longyear Co., E. J.
New York Engineering Co
Sullivan Machinery Co.

**Drums, Magnetic**
Dings Magnetic Sep. Co

**Dryers**
Ruggles-Coles Engrg. Co

**Dryers, Ore**
American Process Co
Bartlett & Snow Co., C. O.
Christie Co., L. R.
Fuller-Lehigh Co.
Morse Bros. Machy. & Supply Co.
Ruggles-Coles Engrg. Co.
Vulcan Iron Works

**Dryers, Sand and Coal**
American Process Co.
Christie Co., L. R.
Ruggles-Coles Engrg. Co.
Vulcan Iron Works

**Dumps, Rotary**
Car Dumper & Equip. Co.

**Dust Protectors (See "Respirators")**

**Electrical Supplies**
Hendrie & Bolthoff M. & S. Co.
Mine & Smelter Supply Co
Ohio Brass Co.

**Elevators, Bucket**
Bartlett & Snow Co., C. O.
Jeffrey Mfg. Co., The
Stephens-Adamson Mfg. Co

**Employees**
Boyle, Jr., John
Marshall, Wm. A.
Scott, G. S.

**Engines, Diesel**
Fulton Iron Works

**Engines, Gas and Gasoline**
Allis-Chalmers Mfg. Co.
Chicago Pneumatic Tool Co
Fairbanks, Morse & Co.
Mine & Smelter Supply Co
Morse Bros. Machy. & Supply Co.

**Engines, Hoisting**
Flory Mfg. Co., S.

**Engines, Oil**
Allis-Chalmers Mfg. Co.
Chicago Pneumatic Tool Co
Fairbanks, Morse & Co.
Fulton Iron Works
Hendrie & Bolthoff M. & S. Co.
Ingersoll-Rand Co.
McIntosh & Seymour Corp.
Morse Bros. Machy. & Supply Co.

**Engines, Steam**
Allis-Chalmers Mfg. Co
Fulton Iron Works
Ingersoll-Rand Co.
Morse Bros. Machy. & Supply Co.

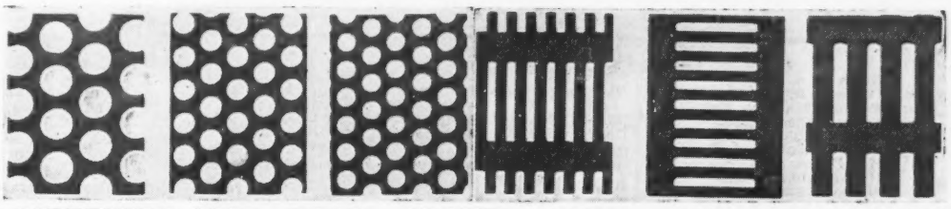
**Exhausters**
Connersville Blower Co
Morse Bros. Machy. & Supply Co.

**Excavators, Cableway**
Lidgerwood Mfg. Co.

**Excavators, Dragline**
Bucyrus Co.
Marion Steam Shovel Co.

# PERFORATED METAL

*All sizes and shapes of Holes*



*All kinds and thicknesses of Metal*

FOR SCREENING ORES—ROCK—GRAVEL—SAND—COAL AND ALL MINERALS

**The Harrington & King Perforating Company**

620 No. Union Avenue, Chicago, Ill., U. S. A. New York Office: 114 Liberty Street

# FJAB

**HOLLOW**
**Rock Drill Steel**

**SOLID**
**Rock Drill Steel**

Hexagon, Octagon, Quarter-Octagon, Round and Cruciform.

**A. MILNE & COMPANY**

(Established 1887)

745 Washington St., New York 8 Oliver St., Boston, Mass.

Chicago Branch: 17-19-21 North May St.

Sole and Direct Representatives for the United States and Canada.

# NICHOLS

**Copper Company**

*Refiners of*

COPPER

*Consignments of Ore, Mattes and Blister Copper Solicited*

*Manufacturers of*

COPPER SULPHATE
(BLUE VITRIOL)

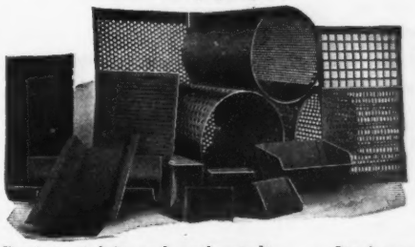
LAUREL HILL, Borough of Queens, New York
and 25 Broad Street, New York

**SCREENS OF ALL KINDS**

**Chicago Perforating Co.**
2445 West 24th Place
Tel. Canal 1459 CHICAGO, ILL.

**Perforated Metal Screens**
*Any Metal*
*Any Style Perforation*
**Pittsburgh Perforating Co.**
3221 Spruce Way, Pittsburgh, Pa.

**HENDRICK SCREENS**
*for every purpose*



Elevator Buckets (plain and perforated) Stacks and Tanks
GENERAL SHEET AND LIGHT STRUCTURAL WORK

**HENDRICK MFG. CO., CARBONDALE, PENNA.**

New York Office: 30 Church St. Pittsburgh Office: 915-916 Union Bank Bldg.
Hazleton, Penna., Office: 705 Markle Bank Bldg.

# WHAT AND WHERE TO BUY

**Excavating Machinery**
Marion Steam Shovel Co.

**Fans, Ventilating**
Buckeye Blower Co.
General Electric Co.
Jeffrey Mfg. Co., The
United Iron Works, Inc.

**Feeders, Ore**
Bartlett & Snow Co., C. O.
James Ore Concent. Co.
Jeffrey Mfg. Co., The
Mine & Smelter Supply Co.
Stephens-Adamson Mfg. Co.

**Filter Cloth**
Filter Fabrics Co.

**Filter Paper**
Denver Fire Clay Co.

**Filter Presses**
Oliver Cont. Filter Co.
United Filters Corp.

**Filters**
Chicago Pneumatic Tool Co.
Oliver Cont. Filter Co.

**Filters, Cloth Metallic**
Oliver Cont. Filter Co.

**Filters, Concentrate**
Oliver Cont. Filter Co.

**Filters, Cyanide**
Oliver Cont. Filter Co.

**Filters, Water**
Scaife, Wm. B., & Sons Co.

**Flood Lighting Projectors**
General Electric Co.

**Flotation Apparatus**
Denver Fire Clay Co.

**Flotation Cell Bottoms, Cloth**
Filter Fabrics Co.

**Flotation Machines**
Butchart, W. A.
Stimpson Equipment Co.

**Flotation Oils**
Barrett Co., The
General Naval Stores Co
Pensacola Tar & Turpentine Co.

**Forges**
Denver Fire Clay Co.
Ingersoll-Rand Co.
Monarch Eng. & Mfg. Co.
Sullivan Machy. Co.

**Forgings, Heavy**
Midvale Steel & Ordnance Co.

**Forgings, Manganese Steel**
Manganese Steel Forge Co.

**Fuel Economizer**
Magnesia Ass'n of Amer.

**Furnaces, Assay**
Braun Corporation, The
Braun-Knecht-Heimann-Co.
Denver Fire Clay Co.
Mine & Smelter Supply Co.

**Furnaces, Bullion Melting**
Denver Fire Clay Co.
Mine & Smelter Supply Co.
Monarch Engrg. & Mfg. Co.

**Furnaces, Crucible Tilting and Refining**
Mine & Smelter Supply Co.
Monarch Engrg. & Mfg. Co.

**Furnaces, Crucible, Tilting Metal**
Mine & Smelter Supply Co.
Monarch Engrg. & Mfg. Co.

**Furnaces, Electric**
Denver Fire Clay Co.
General Electric Co.

**Furnaces Faces and Lining**
Denver Fire Clay Co.

**Furnaces, Heat Treatment**
Denver Fire Clay Co.

**Furnaces, Mechanical Roasting**
Allis-Chalmers Mfg. Co.
General Chemical Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Supply Co.
Worthington Pump & Mchy. Corp.

**Furnaces, Melting**
Denver Fire Clay Co.

**Furnaces, Smelting**
Allis-Chalmers Mfg. Co.
Morse Bros. Machy. & Supply Co.
Worthington Pump & Mchy. Corp.

**Fuses, Electric**
General Electric Co
Westinghouse E. & M. Co.

**Gage Cocks**
Ohio Brass Co.

**Gas**
Ingersoll Rand Co.

**Gas Compressors**
Ingersoll Rand Co.

**Gas Producers**
Wood & Co., R. D.

**Gaskets**
Diamond Rubber Co., The
Smooth-On Mfg. Co.

**Gears**
Caldwell & Son Co., H. W.
Fawcus Machine Co.
General Electric Co.
Jeffrey Mfg. Co., The
Niles-Bement-Pond Co.
Nuttall Co., R. D.
Philadelphia Gear Works
Stephens-Adamson Mfg. Co.
Stroh Steel-Hardening Process Co.

**Gears, Bevel**
Caldwell & Sons Co., H. W.
Fawcus Machine Co.
Philadelphia Gear Works

**Gears, Cut & Cast Tooth**
Jones Fdy. & Mach. Co.

**Gears, Cut and Worm**
Stroh Steel-Hardening Process Co.
United Iron Works, Inc.

**Gears, Herringbone**
Falk Co.
Niles-Bement-Pond Co.
Philadelphia Gear Wks.

**Gears, Spur**
Philadelphia Gear Wks.

**Gears, Worm**
Philadelphia Gear Wks.

**Generators, Electric**
General Electric Co.
Westinghouse E. & M. Co.

**Giants, Water**
Hendy Iron Works

**Glass Blowing**
Denver Fire Clay Co.

**Glassware, Chemical**
Denver Fire Clay Co.

**Gravel Washing Plants**
Stephens-Adamson Mfg. Co.

**Grease**
Cook's Sons, Adam

**Grease Cups**
Cook's Sons, Adam
Lunkenheimer Co.

**Grinders, Manganoid Pebble**
Jeffrey Mfg. Co., The
Braun-Knecht-Heimann-Co.

**Grinders, Chemical Ore**
Braun Corp. Co.
Lidgerwood Mfg. Co.
United Iron Works, Inc.
Vulcan Iron Works

**Grinders, Ore**
Mine & Smelter Supply Co.

**Grinders, Sample**
Mine & Smelter Supply Co.

**Hammers, Forging**
Sullivan Machy. Co.

**Head Frames, Mine**
American Bridge Co.

**Hangers, Mine**
Electric Service Supplies Co.

**Headlights, Incandescent Mine**
Electric Service Supplies Co.
General Electric Co.
Goodman Mfg. Co.
Ohio Brass Co.

**Heaters, Feed Water**
Alberger Pump & Condenser Co.

**Hoists**
United Iron Works, Inc.

**Hoists, Electric**
Allis-Chalmers Mfg. Co.
Brown Hoisting Mchy. Co.
Chicago Pneumatic Tool Co.
English Tool & Supply Co.
Flory Mfg. Co., S.
Hendrie & Bolthoff M. & S.

**Hoists, Gas & Gasoline**
Fairbanks, Morse & Co.
Lidgerwood Mfg. Co.

**Hoists, Head Gate**
Smith Co., S. Morgan

**Hoists, Gas and Gasoline**
Flory Mfg. Co., S.

**Hoists, Mine Compressed Air**
Lidgerwood Mfg. Co.

**Hoists, Mine Steam**
Lidgerwood Mfg. Co.

**Hoists, Portable**
Flory Mfg. Co., S.
Hendrie & Bolthoff M. & S. Co.
Ingersoll-Rand Co.
Lidgerwood Mfg. Co.
Mine & Smelter Supply Co.

**Hoists, Skip**
Bartlett & Snow Co., C. O.
Flory Mfg. Co., S.

**Hoists, Steam**
Allis-Chalmers Mfg. Co.
English Tool & Supply Co.
Flory Mfg. Co., S.
Hendrie & Bolthoff M. & S. Co.
Mine & Smelter Supply Co.
United Iron Works, Inc.

**Hose**
Diamond Rubber Co., The

**Hose, Air**
Denver Rock Drill Mfg. Co.
Ingersoll-Rand Co.

**Hose, Couplings, High Pressure**
Knox Mfg. Co.

**Houses, Steel Shaft**
American Bridge Co.

**Hydraulic Mining Machinery**
Hendy Iron Works

**Hydraulic Trip Controls**
Car Dumper & Equip. Co.

**Idlers, Conveyor**
Conveying Weigher Co.

**Injectors**
Lunkenheimer Co.

**Instruments, Surveying**
Berger & Sons Co., C. L.
Buff & Buff Mfg. Co.

**Insulating Materials, Electric**
Electric Service Supplies Co.
General Electric Co.
Ohio Brass Co.
Westinghouse E. & M. Co.

**Insulating Materials, Heat**
Magnesia Ass'n of Amer.

**Jackets, Water**
Allis-Chalmers Mfg. Co.

**Jigs**
Allis-Chalmers Mfg. Co.
James Ore Concent. Co.
Mine & Smelter Supply Co.
Worthington Pump & Mchy. Corp.

**Joints, Expansion**
Alberger Pump & Condenser Co.

**Kilns, Rotary**
Allis-Chalmers Mfg. Co.
Vulcan Iron Works

**Kilns, Rotary Ore Nodulizers**
Ruggles-Coles Engrg. Co.
Vulcan Iron Works

**Laboratory Machinery**
Braun Corporation, The
Braun-Knecht-Heimann-Co.
Denver Fire Clay Co.
Mine & Smelter Supply Co.
Oliver Cont. Filter Co.

**Lacing, Leather**
Schieren Co., Chas. A.

**Lamps, Electric**
General Electric Co.
Westinghouse E. & M. Co.

**Lead**
American Metal Co.
American Zinc, Lead & Ref. Co.
American Zinc, Lead & Smlg. Co.
Hardy & Ruperti, Inc., Chas.
U. S. Smltg. & Refg. & Mining Co.

**Lightning Arresters**
General Electric Co.
Westinghouse E. & M. Co.

**Line Material, Overhead**
Ohio Brass Co.
Westinghouse E. & M. Co.

**Linings, Ball and Tube Mill**
Allis-Chalmers Mfg. Co.
Fuller-Legigh Co.
Los Angeles Fdy. Co.

**Loading Booms, Adjustable**
Jeffrey Mfg. Co., The

**Loaders, Wagon**
Jeffrey Mfg. Co.

**Locomotives, Compressed Air**
Porter Co., H. K.

**Locomotives, Electric**
General Electric Co.
Goodman Mfg. Co.
Jeffrey Mfg. Co., The
Westinghouse E. & M. Co.

**Locomotives, Electric Storage Battery**
Atlas Car & Mfg. Co.
General Electric Co.
Goodman Mfg. Co.
Jeffrey Mfg. Co., The
Mancha Stor. Batt. Loco. Co.
Westinghouse E. & M. Co.
Whitcomb Co., Geo. D.

**Locomotives, Gasoline**
Hadfield-Penfield Steel Co.
Vulcan Iron Works
Whitcomb Co., Geo. D.

**Locomotives, Industrial**
General Electric Co.
Goodman Mfg. Co.
Jeffrey Mfg. Co., The
Porter Co., H. K.
Whitcomb Co., Geo. D.

**Locomotives, Mine**
General Electric Co.
Goodman Mfg. Co.
Jeffrey Mfg. Co., The
Porter Co., H. K.
Westinghouse Elec. & Mfg. Co.
Whitcomb Co., Geo. D.

**Locomotives, Steam**
Porter Co., H. K.
Vulcan Iron Works

**Locomotives, Storage Battery**
Koppel Ind. Car & Equip. Co.

**Lubricating Oils**
Standard Oil Co.

**Lubricators**
Lunkenheimer Co.

**Machine Tools**
Niles-Bement-Pond Co.

**Machinery, Coal and Ore Handling**
Jeffrey Mfg. Co.

**Magnesia Heat Insulation**
Magnesia Ass'n of Amer.

**Magnetic Pulleys**
Dings Magnetic Sep. Co.

**Magnets, Electro**
Dings Magnetic Sep. Co.

**Magnets, High Intensity**
Dings Magnetic Sep. Co.

**Magnets, Standard and Special**
Dings Magnetic Sep. Co

**Mechanical Draft Apparatus**
Buckeye Blower Co.

**Mechanical Lubricators**
Lunkenheimer Co.

**Metals, Noncorrosive**
International Nickel Co.

**Metals, Perforated**
Allis-Chalmers Mfg. Co.
Harrington & King Perf. Co.
Hendrick Mfg. Co.
Pittsburgh Perforating Co.

**Meters, Electric Current**
General Electric Co.
Westinghouse E. & M. Co.

**Mills, Ball, Tube, Pebble and Rod**
Allis-Chalmers Mfg. Co.
Hendrie & Bolthoff M. & S. Co.
Mine & Smelter Supply Co.
Worthington Pump & Mchy Co.

**Mills, Stamp**
Allis-Chalmers Mfg. Co.
Hendrie & Bolthoff M. & S. Co.
Hendy Iron Works

**Mine Doors, Automatic**
Amer. Mine Door Co.

**Mine Hangers & Insulators**
Electric Service Supplies Co.

**Mixers**
Smith Engrg. Works Co.

**Monel Metal**
International Nickel Co.

**Motors**
Allis-Chalmers Mfg. Co.
Fairbanks, Morse & Co.
General Electric Co.
Westinghouse E. & M. Co.

**Motor Generator Sets**
Fairbanks, Morse & Co.
General Electric Co.
Westinghouse E. & M. Co.

**Motor Control**
General Electric Co.
Westinghouse E. & M. Co.

**Motor Trucks**
Chicago Pneumatic Tool Co

**Netting, Wire**
Ludlow-Saylor Wire Co.

**Nickel**
International Nickel Co.
Nichols Copper Co.

**Nodulizers, Ore**
Vulcan Iron Works

**Oil Cups**
Cook's Sons, Adam
Lunkenheimer Co.

**Ore, Buyers and Sellers of**
American Metal Co.
American Smelting & Rfg. Co.
American Zinc & Chemical Co.
American Zinc, Lead & Smelting Co.
Balbach Smeltg. & Rfg. Co.
Bartlesville Zinc Co.
Grasselli Chemical Co.
Hardy & Ruperti, Inc., Chas.
Hegeler Zinc Co.
Illinois Zinc Co., The
International Smelting Co.
Irvington Smltg. & Rfg. Wks.
Matthiessen & Hegeler Zinc Co.
Pennsylvania Smelting Co.
Phelps, Dodge Corp.
United Metals Selling Co.
United States Smltg., Rfg. & Mining Co.

**Ore, Manganese**
Gailey, Davis & Co.

**Overhead Line Material**
Electric Service Supplies Co
General Electric Co.
Ohio Brass Co.

**Packing**
Diamond Rubber Co., The
Jenkins Bros.

**Packing, Hydraulic**
Schieren Co., Chas. A.

**Paint, Acid Resisting**
Detroit Grapite Co.

**Paint, Metal Protective**
Detroit Grapite Co.

**Paint, Mill-White**
Detroit Grapite Co.

**Paint, Preservative**
Detroit Grapite Co.

**Pebbles, Grinding**
Wood & Co., R. D.

**Perforated Metals (See Metals, Perforated)**

**Pipe Coverings**
Magnesia Ass'n of Amer.

**Pipe Fittings**
Crane Co

**Pipe Fittings, Bronze**
Lunkenheimer Co.

**Pipe, Spiral, Riveted**
Abendroth & Root Mfg. Co.

**Pipe, Steel**
Hendy Iron Works

**Pipe, Wood**
National Tank & Pipe Co.
Pacific Tank & Pipe Co.
Redwood Mfrs. Co.

**Platinum**
Baker & Co., Inc.

**Pneumatic Tools**
Ingersoll-Rand Co.

**Pneumatic Tie Tampers**
Ingersoll-Rand Co.

**Powder, Blasting**
Grasselli Chemical Co.

**Power Plant Equipment**
Crane Co.
General Electric Co.

**Power Transmission Machinery**
Caldwell & Sons Co., H. W.
General Electric Co.
Jones Fdy. & Mach. Co.
Stephens-Adamson Mfg. Co.

**Preservative, Wood (See Creosote)**

**Presses, Filter**
Shriver & Co., T.

**Publishers, Technical Books**
McGraw-Hill Book Co.

**Pulleys, Cast Iron**
Jones Fdy. & Mach. Co.

**Pulleys, Magnetic**
Buchanan Co., Inc., C. G.
Dings Magnetic Sep. Co.

**Pulverized Coal, Systems of**
Bonnot Co., The

**Pulverizers, Coal**
Fuller-Lehigh Co.
Jeffrey Mfg. Co., The

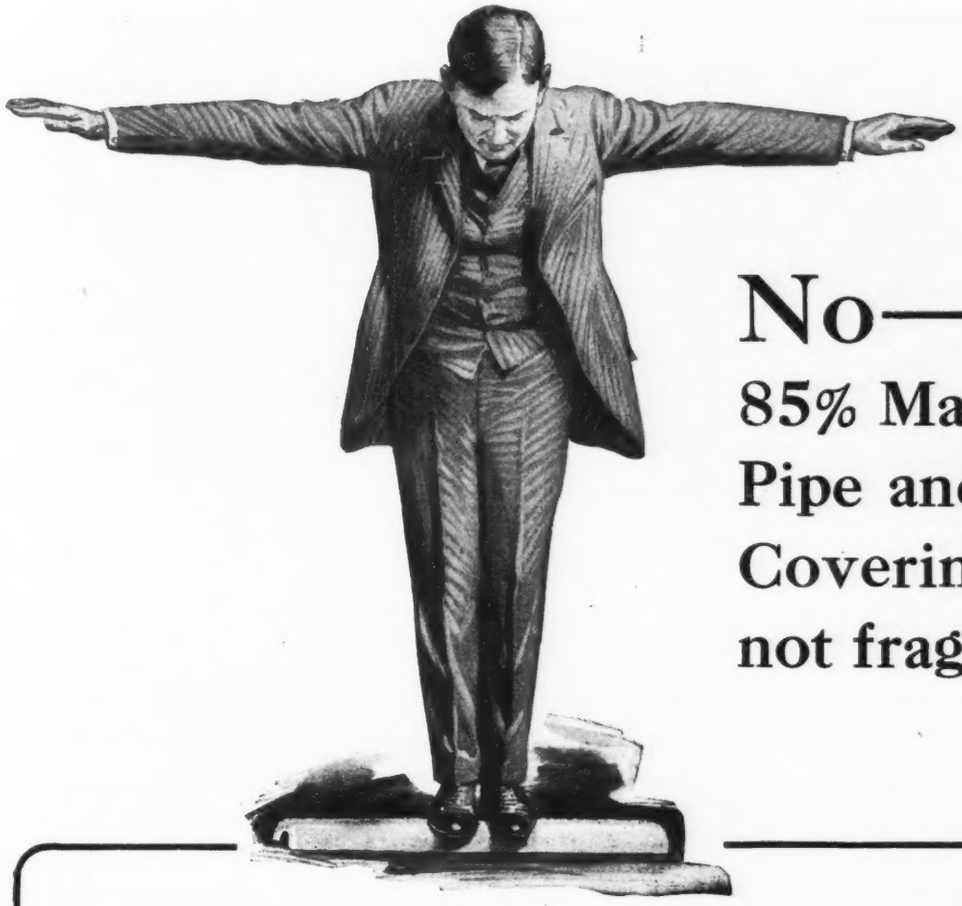
**Pulverizers, Ore**
American Pulverizer Co.
Bartlett & Snow Co., C. O.
Braun Corporation, The
Braun-Knecht-Heimann-Co.
Jeffrey Mfg. Co., The
Mine & Smelter Supply Co.

**Pumping Engines**
Allis-Chalmers Mfg. Co.
Prescott Co., The

**Pumps, Acid**
Byron Jackson Iron Works
Oliver Cont. Filter Co.

**Pumps, Boiler Feed**
Ingersoll Rand Co.
Worthington Pump & Mchy. Corp.

**Pumps, Centrifugal**
Alberger Pump & Condenser Co.
Byron Jackson Iron Works
De Laval Steam Turbine Co.
Fairbanks, Morse & Co.
Ingersoll Rand Co.
Krogh Pump & Machy. Co.
Mine & Smelter Supply Co.
Oliver Cont. Filter Co.
United Iron Works, Inc.
Worthington Pump & Mchy. Corp.



# No—
## 85% Magnesia Pipe and Boiler Covering is not fragile

Nearly everybody jumps to the conclusion that an article of light weight has little strength. The thoughts are naturally associated.

But the truth is that 85% Magnesia combines light weight and strength.

The illustration above, sketched from a photograph, shows a heavy man standing on a half section of 85% Magnesia Pipe Covering. Had you any idea that 85% Magnesia possessed such strength? — Do you doubt it? Then try it yourself.

Pipe coverings need not hang in shreds on the pipe to be considered as having failed. *The most frequent failure is sagging.* If the covering sags only $\frac{1}{4}$ of an inch it has failed.

As weight induces sagging, it is extremely important that a pipe covering be as light as possible. The rigidity of 85% Magnesia holds each section snugly to the pipe.

85% Magnesia combines light weight with great strength; one feature is not sacrificed for the other. This is one — only one — reason why 85% Magnesia is the *Universal* Coal Saver.

Other vital facts with respect to insulation are given in our revised book "Defend Your Steam," furnished free to every responsible person.

## Magnesia Association of America
**752 Bulletin Building, Philadelphia, Pa.**

*Executive Committee: Wm. A. Macan, Chairman*

| | | |
|---|---|---|
| George D. Crabbs | The Philip Carey Co. | Cincinnati, Ohio |
| Alvin M. Ehret | Ehret Magnesia Mfg. Co. | Valley Forge, Pa. |
| J. R. Swift | The Franklin Mfg. Co. | Franklin, Pa. |
| R. V. Mattison, Jr. | Keasbey & Mattison Co. | Ambler, Pa. |

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# WHAT AND WHERE TO BUY

**Pumps, Deep Well**
Byron Jackson Iron Works
Ingersoll Rand Co.
United Iron Works, Inc.

**Pumps, Electric**
Alberger Pump & Condenser Co.
Byron Jackson Iron Works
Hendrie & Bolthoff M. & S. Co.
Ingersoll Rand Co.
Krogh Pump & Machy. Co
Oliver Cont. Filter Co.
Prescott Co., The

**Pumps, Hydraulic**
Prescott Co., The

**Pumps, Mill**
Frenier & Son, J. H.
Ingersoll Rand Co.
Krogh Pump & Machy. Co.
Oliver Cont. Filter Co.
Prescott Co., The

**Pumps, Mine**
Alberger Pump & Condenser Co.
Allis-Chalmers Mfg. Co.
Fairbanks, Morse & Co.
Hendrie & Bolthoff M. & S. Co.
Ingersoll Rand Co.
Krogh Pump. & Machy. Co.
Mine & Smelter Supply Co.
Prescott Co., The
United Iron Works, Inc.
Worthington Pump & Mchy. Corp

**Pumps, Pneumatic Air Lift**
Sullivan Machy. Co.

**Pumps, Power Plant**
Alberger Pump & Condenser Co.
Fairbanks, Morse & Co.
Prescott Co. The

**Pumps, Reciprocating**
Prescott Co., The

**Pumps, Sand, Slime and Tailings**
Byron Jackson Iron Works
Dorr Co., The
Frenier & Son, J. H.
Krogh Pump & Machy. Co.
Worthington Pump & Mchy. Corp.

**Pumps, Sinking**
Byron Jackson Iron Works
Ingersoll Rand Co.
Krogh Pump. & Machy. Co.
Prescott Co., The
Worthington Pump & Mchy. Corp.

**Pumps, Steam**
Prescott Co., The

**Pumps, Vacuum**
Chicago Pneumatic Tool Co.
Connersville Blower Co.
Ingersoll-Rand Co.
Oliver Cont. Filter Co.
Sullivan Machy. Co.

**Rail Bonding Tools**
Electric Service Supplies Co.
Ohio Brass Co.

**Rail Bonds**
Electric Service Supplies Co.
General Electric Co.
Ohio Brass Co.

**Rails, Light Steel**
West Virginia Rail Co.

**Railways, Narrow Gage**
Easton Car & Const. Co.

**Refractories**
Harbison-Walker Refrac. Co.

**Respirators**
Diamond Rubber Co., The

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**Second-Hand Machinery (See Searchlight Section)**
Curtiss-Willis Co.
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**Shaft Sinking**
Longyear Co., E. J.

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**Skips**
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**Smelters**
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Ingersoll-Rand Co.
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United Iron Works, Inc.
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Midvale Steel & Ordnance Co.
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**Stokers, Mechanical**
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**Switchboards**
Allis-Chalmers Mfg. Co.
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**Switchboards, Telephone**
Stromberg-Carlson Telep. Mfg. Co.

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**Tanks, Wood**
Mine & Smelter Supply Co
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**Transformers, Electric**
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**Trolley Line, Material**
Electric Service Supplies Co.
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**Tungsten**
Hardy & Ruperti, Inc., Chas.

**Turbines, Hydraulic**
Allis-Chalmers Mfg. Co.
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**Turbines, Steam**
Allis-Chalmers Mfg. Co.
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**Valves, Check**
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Amer. Steel & Wire Co
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**Wire Welding**
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American Metal Co.
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Auburn, New York

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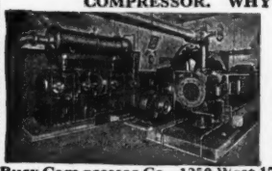

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Manufacturers of Mine-A-Phones, Telephone Switchboards, Desk Telephones, Wall Telephones, and Associated Equipment.

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Good house paint tells its quality story year after year—not only during the first few months of service. Most any paint looks good for a time, but its real worth is demonstrated only by length of service it gives. If paint falls down in service after a short period its use represents loss regardless of the initial cost.

You combine sound business judgment and real economy when you buy ***Degraco House Paints***. They are made right from the start—have proven their worth in service and are recognized and used because of their durability and low ultimate cost.

***Degraco House Paints*** are made in all colors. They are backed by the reputation of the Detroit Graphite Company as makers of good paint for thirty years and can be used without the hazard of experiment.

***Degraco House Paint*** outside
***Degraco Gloss Colors*** inside

**Detroit Graphite Company**

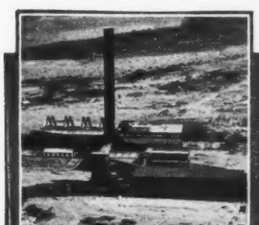
*Makers of*
*Paints in all Colors for all Purposes*

**509 Twelfth St. Detroit, U. S. A.**

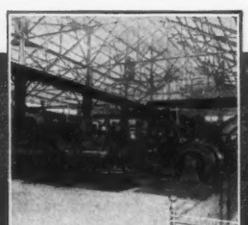
***Sold through Branch Offices with warehouse stocks in all Principal Cities***

Mfd. in Canada by Dominion Paint Works, Ltd., Walkerville, Ont.

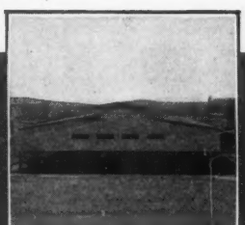
(63)



**Superior Graphite Paint**—*a protective coating for structural steel, bridges, metal roofs, stacks and all metal surfaces.*



**Sta-White**—*a pure white, light-reflecting oil paint for interiors of power houses, shops, storehouses, offices, hospitals, etc.*



**Degraco Paints and Enamels** *are made in all colors for use on interior and exterior surfaces, for every service requirement.*

**Degraco Brick and Concrete Paints**—*for interiors and exteriors. Concrete Walls, Floor Paint, Floor Hardener, Damp-proofing.*

**Degraco House Paints**—*all colors for exterior and interior surfaces. High quality and durability assure low ultimate cost.*

# DEGRACO PAINTS

## All Colors for All Purposes

# ALPHABETICAL INDEX TO ADVERTISERS


| | Page |
|---|---|
| Abendroth & Root Mfg. Co. | 37 |
| Alberger Pump & Condenser Co. | 42 |
| Allis-Chalmers Mfg. Co. | 11 |
| Ameling Prospecting Co., Inc., H. R. | 44 |
| American Bridge Co. | 37 |
| American Cyanamid Co. | 31 |
| American Metal Co., Ltd., The | 51 |
| American Mine Door Co., The | 24 |
| American Process Co. | 45 |
| American Pulverizer Co. | 42 |
| American Sheet & Tin Plate Co. | 37 |
| American Smelting & Refining Co. | 55 |
| American Steel & Wire Co. | 40 |
| American Zinc & Chemical Co. | 54 |
| American Zinc, Lead & Smelting Co. | 52 |
| Armstrong Mfg. Co., The | 36 |
| Atlas Car & Mfg. Co., The | 34 |
| Bacon, Earle C., Engineer | 42 |
| Baker & Co., Inc. | 51 |
| Balbach Smelting & Refining Co. | 54 |
| Barrett Co., The | 51 |
| Bartlesville Zinc Co. | 54 |
| Bartlett & Snow Co., The C. O. | 45 |
| Bethlehem Shipbuilding Corp. | 38 |
| Berger & Sons, C. L. | 38 |
| Bonnot Co., The | 43 |
| Braun Corporation, The | 40 |
| Braun-Knecht-Heimann-Co. | 40 |
| Broderick & Bascom Rope Co. | 40 |
| Brown Hoisting Machinery Co., The | 38 |
| Buchanan Co., Inc., C. G. | 43 |
| Buckeye Blower Co. | 45 |
| Bucyrus Co. | 38 |
| Buff & Buff Mfg. Co. | 39 |
| Bury Compressor Co. | 60 |
| Butchart, W. A. | 41 |
| Byron Jackson Iron Works Inc. | 32 |
| Caldwell & Son Co., H. W. | 36 |
| Cambria Steel Co. | 43 |
| Car Dumper & Equipment Co. | 35 |
| Cement Gun Co., Inc. | 30 |
| Chicago Perforating Co. | 57 |
| Chicago Pneumatic Tool Co. | 21 |
| Christie Co., L. R. | 45 |
| Cochise Machine Co. | 44 |
| Connersville Blower Co., The | 44 |
| Conveying Weigher Co., The | 36 |
| Cook's Sons, Adam | 62 |
| Crane Co. | 20 |
| Deister Concentrator Co., The | 5 |
| Deister Machine Co. | 41 |
| De Laval Steam Turbine Co. | 42 |
| Denver Fire Clay Co., The | 38 |
| Denver Rock Drill Mfg. Co., The | 7 |
| Detroit Graphite Co. | 61 |
| Diamond Rubber Co., The | 4th Cover |
| Dings Magnetic Separator Co. | 3rd Cover |
| Directory of Engineers | 46 |
| Dobbins Core Drill Co., Inc. | 44 |
| Dorr Co., The | 42 |
| Easton Car & Construction Co. | 35 |
| English Tool & Supply Co., The | 39 |
| Fairbanks, Morse & Co. | 33 |
| Falk Corporation, The | 39 |
| Fawcus Machine Co. | 39 |
| Filter Fabrics Co., The | 51 |
| Flory Mfg. Co., S. | 39 |
| Frenier & Son, J. H. | 42 |
| Fuller-Lehigh Co. | 45 |
| Fulton Iron Works Co. | 9 |
| Gailey, Davis & Co. | 51 |
| General Chemical Co. | 41 |
| General Electric Co. | 27 |
| General Naval Stores Co. | 51 |
| Goodman Mfg. Co. | 62 |
| Grasselli Chemical Co., The | 54 |
| Hadfield-Penfield Steel Co., The | 34 |
| Harbison-Walker Refractories Co. | 38 |
| Hardy & Ruperti, Inc., Chas. | 52 |
| Harrington & King Perforating Co, The | 57 |
| Hazard Mfg. Co. | 22 |
| Hegeler Zinc Co, The | 52 |
| Hendrick Mfg Co. | 57 |
| Hendrie & Bolthoff Mfg. & Supply Co, The | 6 |
| Hendy Iron Works, Joshua | 24 |
| Illinois Zinc Co. | 52 |
| Ingersoll-Rand Co. | 17-18 |
| International Nickel Co., The | 52 |
| International Smelting Co. | 53 |
| Interstate Equipment Corp. | 40 |
| Irvington Smelting & Refining Works | 52 |
| James Ore Concentrator Co. | 41 |
| Jeffrey Mfg. Co., The | 4 |
| Jenkins Bros. | 37 |
| Jones Foundry & Machine Co., W. A. | 36 |
| Knox Mfg. Co. | 38 |
| Koppel Industrial Car & Equipment Co. | 35 |
| Krogh Pump & Mchy. Co., The | 42 |
| Lake Superior Loader Co. | 12 |
| Leschen & Sons Rope Co., A. | 40 |
| Lidgerwood Mfg. Co. | 39 |
| Longyear Co., E. J. | 44 |
| Los Angeles Foundry Co. | 42 |
| Ludlow-Saylor Wire Co., The | 8 |
| Lufkin Rule Co., The | 39 |
| Lunkenheimer Co., The | 25 |
| Magnesia Association of America | 59 |
| Mancha Storage Battery Locomotive Co. | 62 |
| Manganese Steel Forge Co. | 42 |
| Marion Steam Shovel Co., The | 38 |
| Matthiessen & Hegeler Zinc Co. | 52 |
| McGraw-Hill Book Co. | 33 |
| McIntosh & Seymour Corp. | 60 |
| McKiernan-Terry Drill Co. | 44 |
| Midvale Steel & Ordnance Co. | 43 |
| Milne & Co., A. | 57 |
| Mine & Smelter Supply Co., The | 43 |
| Monarch Eng. & Mfg. Co., The | 41 |
| Morse Bros. Machinery & Supply Co. | 43 |
| Myers-Whaley Co. | 38 |
| National Tank & Pipe Co. | 36 |
| New York Engineering Co. | 38 |
| Nichols Copper Co. | 57 |
| Niles-Bement-Pond Co. | 39 |
| Nuttall Co., R. D. | 16 |
| Ohio Brass Company, The | 36 |
| Oliver Continous Filter Co. | 50 |
| Osgood Co., The | 38 |
| Pacific Tank & Pipe Co. | 36 |
| Pennsylvania Drilling Co. | 44 |
| Pennsylvania Smelting Co. | 51 |
| Pensacola Tar & Turpentine Co. | 51 |
| Phelps Dodge Corp. | 51 |
| Philadelphia Gear Works | 14 |
| Pittsburgh Perforating Co. | 57 |
| Porter Co., H. K. | 62 |
| Power Specialty Co. | 37 |
| Prescott Co., The | 15 |
| Redwood Mfrs. Co. | 13 |
| Riblet Tramway Co. | 40 |
| Robins Conveying Belt Co. | 36 |
| Roebling's Sons Co., John A. | 42 |
| Roessler & Hasslacher Chemical Co., The | 52 |
| Ruggles-Coles Eng. Co. | 45 |
| Scaife & Sons Co., Wm. B. | 38 |
| Schieren Co., Chas. A. | 36 |
| Searchlight Section | 28-29 |
| Shriver & Co., T. | 50 |
| Smith Engineering Works | 23 |
| Smith Co., S. Morgan | 42 |
| Smith & Travers Co., Ltd. | 44 |
| Smooth-On Mfg. Co. | 37 |
| Standard Oil Co. | 35 |
| Stearns-Roger Mfg. Co., The | 42 |
| Stephens-Adamson Mfg. Co. | 2d Cover |
| Stimpson Equipment Co. | 43 |
| Stroh Steel-Hardening Process Co. | 30 |
| Stromberg-Carlson Telep. Mfg. Co. | 60 |
| Sullivan Machinery Co. | 10, 44 |
| Union Construction Co. | 38 |
| United Iron Works, Inc. | 51 |
| United Metals Selling Co. | 53 |
| United States Smelting Refining & Mining Co. | 55 |
| Vulcan Iron Works | 19 |
| Watt Mining Car Wheel Co., The | 34 |
| Westinghouse Electric & Mfg. Co. | 32 |
| West Virginia Rail Co., The | 62 |
| What and Where to Buy | 56 |
| Whitcomb Co., Geo. D. | 35 |
| Wisconsin Bridge & Iron Co. | 62 |
| Wood & Co., R. D. | 36 |
| Worthington Pump & Mch'y. Corp. | 26 |
| Yuba Mfg. Co., The | 38 |


## INDEX TO SEARCHLIGHT SECTION


| | | | |
|---|---|---|---|
| Boyle, Jr., John | 28 | Donahoo Co., J. F. | 29 |
| Curtiss Willis Co. | 29 | Harris Bros. | 29 |
| Hefner, W. A. | 28 | Heineken, W. P. | 29 |
| Marshall, Wm. A. | 28 | Merchants Steel & Supply Co. | 29 |
| Scott, G. S. | 28 | | |



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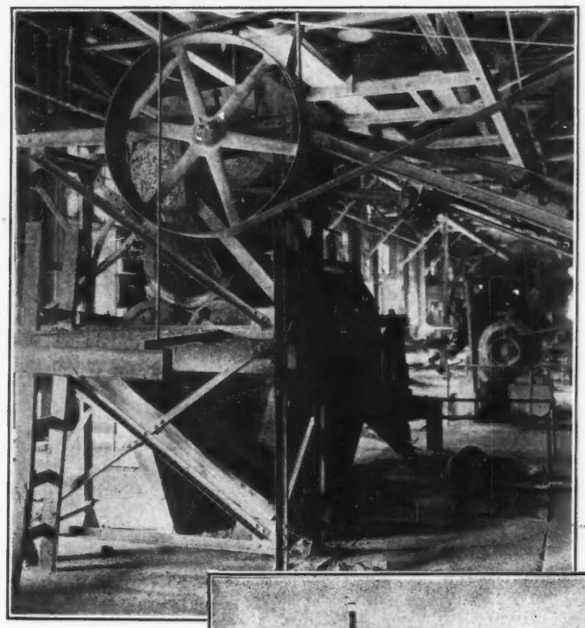
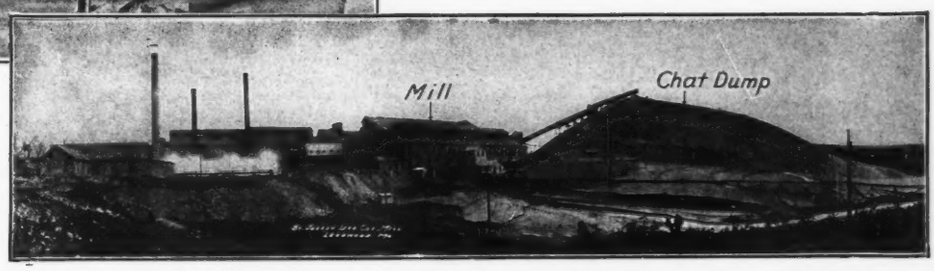


## The St. Joseph Lead Company Has Six Dings Pulleys in Their River Mines Mill




The illustration shows but one plainly; however, all six have been in operation since 1909, handling about 600 tons each of ore per day.

They are discharging the belt load into trommels. How free from tramp iron the discharge is may be judged from the assortment of material shunted to the floor.

Dings Magnetic Pulleys are correct—electrically and mechanically—and they positively remove every piece of tramp iron, large or small.

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*Home Office and Works*

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**DENVER** 1718 California Street

DINGS

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**RICHMOND** 1905 E. Main Street

—*at King Solomon's Mines* 1921 A. D.

Here is a Diamond Conveyor Belt working at the ancient diggings in Africa, whence came the gold, according to legend, for the temple of Solomon.

Fancy how much richer Solomon would have been had he possessed a Diamond Conveyor Belt and modern mining methods. This belt handles loads like this daily—does more in a week than a horde of Solomon's slaves could in a month, and actually at a lower cost per ton (for food and clothing for slaves cost something even in those days).

Incidentally, South African mining interests have been buying Diamond Belts for many years—ever since American Engineers showed how mining could be done economically. Just as popular here in America.

THE DIAMOND RUBBER COMPANY, INC., *Akron,* OHIO

# Diamond
## *Conveyor* BELTS